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# CORNELL UNIVERSITY MEDICAL BULLETIN

VOLUME X NUMBER 1

JULY, 1920

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## STUDIES FROM THE Department of SURGERY

1918/20

PUBLISHED BY CORNELL UNIVERSITY
477 FIRST AVENUE
NEW YORK CITY

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1918-1920

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# AN ANALYSIS OF THE RESULTS OF SIX YEARS' FOLLOW-UP SYSTEM IN A HOSPITAL SURGICAL SERVICE*

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SURGEON TO THE FIRST (CORNELL) SURGICAL DIVISION, NEW YORK HOSPITAL

THIS paper is a study of the end results obtained in the First Surgical Division of the New York Hospital from February 1, 1913, to January 1, 1919. This period covers 8456 patients, 7175 operations, 385 deaths. Sixty of these deaths were on non-operative cases. The cases have been followed according to the outline given in my paper, "A Surgical Follow-Up System," in the ANNALS OF SURGERY of September, 1916.

Briefly, the great bulk of cases, exception only being made for minor infections, etc., are examined three months after operation by the surgeon in whose charge the patient was or who performed the operation. Patients not reporting are written to. The excellent Social Service Department of the hospital has been able to trace numerous cases and give us some information about their condition. Cases of particular interest are followed for longer periods; for instance, the direct herniæ are followed for nine months, malignant tumors indefinitely. Patients are directed at the time they leave the hospital and also when they return for examination to come back to see the attending surgeon if at any time they develop symptoms or complaints. They are particularly encouraged to come on Mondays at three o'clock, which is our Field Round day, and the entire staff is present.

The condition of the patients is indicated as follows: *Excellent* means that the patient returns presenting absolutely no symptoms of any kind whatsoever and expresses himself in perfect health and perfectly satisfied with his surgical condition. *Satisfactory* means that there are no direct symptoms referable to his surgical condition, but that the patient may have some complaint, be that as it may, *e.g.,* constipation. *Unsatisfactory* means that the patient has not been improved or that there is a definite failure to obtain the desired results.

We have reason to believe that the tabulated results are made to appear bad by the fact that a large number of patients remaining in good health and having no complaints, do not respond to requests for information or examination. A very large proportion of these patients are recent and ignorant immigrants who exhibit little gratitude for benefits received, certainly not enough to give up half a day's work to report. *Per contra,* if anything is the matter with them, they are very anxious to confront the doctor with the fact.

* Read before the New York Surgical Society, November 12, 1919.

The work has been done for the most part by myself and the two associate surgeons, Dr. B. J. Lee and Dr. J. M. Hitzrot. In the first part of 1913 it was our privilege to have the coöperation of Dr. W. A. Downes who was then associate surgeon. Dr. C. E. Farr, assistant surgeon, also has taken part in some of the work and particularly during the period of the war.

Two periods of these six years have given unsatisfactory results. The system began in 1914; but for the sake of completeness, we went back and investigated, so far as we were able, our 1913[1] work, but were unable to trace a considerable portion of these cases. From July, 1917, to the end of this period war conditions materially handicapped us.

The responsibility of keeping track of these patients and sending for them has been entirely in the hands of Mrs. H. S. Harrison, and it is largely owing to her coöperation and the fact that this responsible part of the work has been done by one person that we have been able to get data of value.

Space will not allow of very detailed comments of these cases. Some of the more important groups will be the basis of papers to be published by the staff.

Whatever merit this publication may contain is believed to be due to the complete report of the entire service for six consecutive years, as studies of this kind are rare.

The First Surgical Division of the New York Hospital is under the control of Cornell Medical College and for eight months of the year there is very active teaching.

So far as feasible, some of the major groups of cases are assigned to particular members of the staff. For purposes of convenience, a certain uniformity of technic obtains; but the staff is not limited to any one method of treatment. This policy gives the individual operator opportunities to develop his own ideas and furnishes a comparison of different methods.

In the past year we have replaced disinfection of the skin by tincture of iodine by 5 per cent. picric acid alcohol solution and are much better satisfied with the results. The asepsis obtained is fully as good, probably better, and the occasional irritation such as is produced by iodine has become a thing of the past.

Two and a half years ago it was believed that better results would be obtained by discarding the newer methods of anæsthesia and in that period of time, with very rare exceptions, general anæsthesia has been obtained entirely by drop ether on the open cone. It is interesting to note that this method (suppressing preliminary nitrous oxide) does not result in any increased use of ether for the average anæsthesia. As time goes on we shall investigate whether the suppression of nitrous oxide has had any relation to the incidence of pulmonary embolism. It is my impres-

[1] The Division has been conducted by the Cornell Medical College since 1913.

sion that pulmonary embolism became more marked about the time that complicated methods of anæsthesia, particularly those involving the use of nitrous oxide, were introduced.

Anæsthesia for five years has been in charge of Dr. W. L. Soule and this centralization in the hands of an expert has been attended with the very best results. We have had no case in which death could be attributed directly or indirectly to the anæsthetic.

I would make a plea for general anæsthesia, versus the routine use of local anæsthesia, which is employed by a good many surgeons, if given in a safe and controllable manner, namely, ether, open cone, by a responsible expert. While local anæsthesia undoubtedly has a very definite place in a certain group of cases, it is believed it has, on the whole, little or no effect in diminishing mortality.

A certain number of deaths from pulmonary embolism, infarct and thrombosis have been accepted by the surgical profession as seemingly inevitable. Many theories have been advanced to explain their occurrence, but none seems to furnish the true explanation. In all reports one thing stands out prominently; that is, that this condition follows operations below the diaphragm. In a previous paper [2] I have called attention also to the average age of the patients, namely, a large proportion occurring in middle or late life. My observations also rather combated the late development of these conditions. The cases here reported were also all below the diaphragm but showed an average age of about thirty-two years, an average development of symptoms five days after operation, death about five days later. (Exception is made of case which died sixty-seven days after operation.)

Our results may be considered from the standpoint of mortality and the restoration of function or return to health of patients. Results will fall into three main groups; namely *Good* (Group I), that is, as satisfactory as at present it is possible to expect; *Average* results (Group II), that is, no better or no worse than what we may commonly expect; and sufficiently *Bad* (Group III) to cause us disquiet and to seek for improvement of results.

Leaving aside the smaller groups for important subjects we have under Group I as follows:

GROUP I

MALFORMATIONS.[3]—These give good results, particularly in undescended testicle. The deaths were from extreme causes, such as spina bifida.

CIRCULATORY SYSTEM.—Forty-four operations for varicose veins [4] with only two unsatisfactory results.

DIGESTIVE SYSTEM.—*Acute appendicitis,* 782 operations; 34 deaths (4.3 per cent.) can, I think, be classified as good in view of the class of cases admitted. A very large proportion are long delayed cases as our unfor-

[2] Pulmonary Embolism Following Operation, Medical Record, January 9, 1909.

[3] The Bellevue Nomenclature is employed in all tabulations.

[4] This group will be the subject of a special paper.

tunate patients are of a class that does not seek early advice and does not always receive prompt attention, necessitating, necessarily, severer operations and greater risks. We are under the impression to-day that if anything, the delay in sending in cases is increasing. Only five cases of this group are noted as coming back with conditions marked unsatisfactory; in marked contrast with the large number of cases of chronic appendicitis presenting subsequent complaints.

SUMMARY OF DEATHS FROM ACUTE APPENDICITIS

| | |
|---|---|
| Number of deaths | 36 |
| Males, 18, females, 18 | |
| Number of operations | 34 |

*Ages*

| | |
|---|---|
| 1–10 years | 5 |
| 10–15 years | 6 |
| 15–20 years | 3 |
| 20–30 years | 8 |
| 40–50 years | 6 |
| 50–60 years | 6 |
| 60–70 years | 2 |

*Time Elapsing Between Onset of Attack and Operation*

| | |
|---|---|
| 1 day | 3 |
| 2 days | 12 |
| 3 days | 3 |
| 4 days | 3 |
| 5 days | 5 |
| 6 days | 2 |
| 8 days | 1 |
| 2 weeks | 2 |

One case too ill to give a history. Another ill four weeks. No definite history of acute attack.

All cases save one required drainage. All were complicated by peritonitis. Further complications were:

| | |
|---|---|
| Pneumonia | 2 |
| Intestinal obstruction | 4 |
| Paralytic ileus | 1 |
| Pneumococcus infection | 1 |
| Suppurative pleurisy, necessitating second operation | 2 |
| Pulmonary infarct | 3 |
| Acute cholecystitis | 1 |
| Secondary exploration of subphrenic space for multiple abscess of liver | 1 |
| Acute cardiac dilatation | 1 |
| Nephritis | 2 |

*Tonsils,* 559 operations with one death. This death was in no way connected with the operation, but the patient died eleven days after the opera-

tion of meningitis. The operation performed was usually some form of radical enucleation and the functional results were exceedingly good.

*Hemorrhoids,* 184 operations, no deaths. Only 3 unsatisfactory results. This result was an agreeable surprise to us, for without this definite tabulation we would not have realized how uniformly successful this operation was.

HERNIÆ.—*Femoral hernia,* 53 operations, 1 death. No recurrences. Unsatisfactory cases are those showing same pain as before operation, but no recurrence.

*Femoral hernia, strangulated,* 11 operations, 1 death, gave uniformly good after results.

*Inguinal hernia.* Of 849 operations, 168 were for bilateral hernia. Total number of operations, therefore, 933. Of the 65 cases of bilateral hernia operated on before 1916, 61 were operated on at one sitting, two at two sittings. From 1916 to 1919 of 103 bilateral herniæ, 96 were operated on at one sitting, 7 at two sittings. Of these 103 cases, 15 were direct, 68 indirect, 20 both direct and indirect. Since 1916 there have been 305 cases of hernia on the right side (including bilateral hernia). Of this number 142 have had their appendix removed.

There were two deaths; in one case from pulmonary embolism after a long illness. In this case the appendix had been removed with great difficulty. The second was an elderly man, a poor risk, who died from cardiac insufficiency and paralytic ileus. So far as mortality is concerned we believe our results are good, as owing to the greater demands for operation to-day the average age is much higher than it was some years ago. For some years we had made a practice of removing the appendix on the right side in a rather haphazard fashion, but to-day we make it a routine providing the conditions allow of a perfectly safe and easy removal, as we believe no risks should be taken of unduly traumatizing the intestine. It is interesting to note that three patients in whom the appendix was sought for and the search abandoned for the above reasons, subsequently returned to us for an operation for acute appendicitis. Possibly in cases where we cannot easily draw down the appendix and cæcum, there may be a chronic appendicitis which calls for operation. It has been interesting to note with what frequency the appendices removed as routine have shown pathological lesions, concretions, etc. In one case the appendix was full of pus.

As regards recurrences [5] we have definite knowledge of only 20 but believe that it must be higher. We believe that the direct herniæ are more prone to recur and require special technic. We believe that we present here a higher percentage of operations for direct herniæ than is commonly reported, and attribute the fact to our methods of demonstrating the presence of direct hernial sacs which are often overlooked unless care is taken in searching for them. In fact, we have come to regard this careful extirpation of the entire direct

[5] This group will be the subject of a special paper.

sac as the most important feature in obtaining a radical cure in addition to the special technic of replacing the deficient conjoined tendon, either by transplantation of the rectus, or, in addition, suturing the cut edge of the rectus sheath to Poupart's ligament.

INFECTIVE DISEASES.—*Tetanus,* 3 cases, all recovered. All treated by intraspinal injections of antitoxin in addition to other treatment.[6]

*Tuberculosis of kidney,* 15 operations without mortality. One subsequently died at home; in two the end results are not known. In the others the improvement in health and the disappearance of symptoms were for the most part very marked and gratifying.

REPRODUCTIVE ORGANS (FEMALE).—*Extra-uterine gestation,* 51 operations, 2 deaths. Many of these are ambulance cases, desperately ill. It is, therefore, fair to consider the mortality, 4 per cent., very good.

*Chronic salpingitis,* 211 operations, 5 deaths, represent in many cases very severe conditions, long neglected cases, and huge suppurating tubes. Our experience has taught us that so-called conservative measures, *i.e.,* saving a doubtful second tube or partial resection of a tube, are unsatisfactory; in fact, they generally leave the patient in a bad condition and more usually necessitate a second operation. Bilateral cases are best treated by a panhysterectomy, for, as a general rule, leaving a boggy incurably diseased uterus is poor surgery.

REPRODUCTIVE ORGANS (MALE).—*Hydrocele,* 62 operations; *variococele,* 78 operations, gave surprisingly good results. The operation usually employed for varicocele was the high excision of veins; for hydrocele, radical excision, chiefly by von Bergmann's method.

TUMORS (BENIGN).—*Fibromyoma of uterus* gives a small mortality and very satisfactory after results.

*Fibro-adenoma of breast.* These operations, if done properly, with the Thomas special submammary incision, give excellent results, especially from the cosmetic standpoint. In only two of these patients are recurrences noted and probably from insufficient excision. I would like to call attention to the fact that in the twenty-five years of my hospital surgery I have performed a goodly number of operations for benign conditions of the breast which I believe have acted as a prophylaxis against carcinoma. I have never yet had one of these patients return to me with carcinoma of the breast or have I ever heard of such a condition developing in any of my patients.

URINARY ORGANS.—*Nephrolithiasis and calculus in ureter,* 52 cases, 30 operations, 2 deaths which were exaggerated conditions, requiring a nephrectomy in the presence of a marked pyonephrosis. It will be noted that operations for displaced kidney (nephroptosis) were very infrequent as we believe they should be.

*Abscess of kidney and perinephritic abscess,* 28 operations, 2 deaths. Results excellent, only two cases being reported unsatisfactory.

[6] See article, "Comparative Value of the Methods of Treating Tetanus," in the American Journal of the Medical Sciences, December, 1916.

Ductless Glands and Spleen.—*Diseases of the spleen*[7] (*including ecchinococcus cyst*), 12 cases, 10 operations, 1 death. The fatal case was one of splenomyelogenous leukæmia in which nothing further than an exploration was possible.

Of the splenectomies, 1 Banti's disease, 1 syphilitic enlargement, 1 von Jaksch's anæmia, 1 hæmolytic jaundice, 1 pernicious anæmia, and 1 ecchinococcus cyst have remained well, all with marked improvement.

One Banti's disease, 1 portal cirrhosis with splenomegaly (non-alcoholic), and 1 pernicious anæmia died after short improvement.

Injuries.—*Fractures* (*including faulty union*). During the period of these statistics 447 fractures were treated. There were 24 deaths (14 in the skull fractures). Two hundred and thirty-six cases reported for observation; of these 53 were excellent, 163 satisfactory, and 21 unsatisfactory. Forty-seven cases were not asked to return because the treatment received at the hospital could have no bearing on the result.

One hundred and sixty-eight operations[8] were done with 12 deaths; 10 in fractures of the skull, 2 in fractures of the femur (shock, 1; pulmonary embolism, 1).

The operative measures used with autogenous bone grafts, 30 cases (4 failures with subsequent operations in 2 cases); heterogeneous bone graft (beef bone) in 6 cases with 1 failure; Lane plate, 28 cases with 1 infection and 2 removals; Freeman external bone clamp, 2 cases; Quenu-Matthieu apparatus, 2 cases; suture of fragments, 33 cases; wiring, 2 cases; metal screw, 1 case; nail extension, 1 case; osteotomy, 9 cases; excision of fragments, 12 cases; arthroplasty for ankylosis following fracture, 6 cases; amputation, 8 cases. The remaining 30 operations were done to correct deformities which after correction needed no fixation or for coincident soft part injury (skull fractures).

GROUP II

Digestive System.—*Cholelithiasis and cholecystitis,* 214 cases, 179 operations, 12 deaths. Many of these cases presented the terminal stages of severe infections and numerous cases of obstructive jaundice. It is not surprising, therefore, that the mortality should be a little high. The results, on the whole, were pretty fair, but we feel that we must exert considerable efforts to improve them. As regards cholecystotomy versus cholecystectomy, as time goes on the latter operation has been more frequently performed so that it is to-day the routine operation that we perform with improvement of results. A few cases have been encountered with carcinoma of the gall-bladder developing after a cholecystotomy some time before. A cholecystectomy done at the primary operation

[7] "The Effect of Splenectomy on the Normal Individual and in Certain Pathological Conditions," by James Morley Hitzrot, Annals of Surgery, May, 1918.

[8] The large number of operations is due to the fact that a great many of these cases are those in which the original treatment outside the hospital has not been satisfactory and they have been sent to the hospital for correction.

would probably have eliminated the possibility of the carcinoma developing.

There has been no attempt to make use of the transverse incision for gall-bladder approach, as we have found in cases of common duct obstruction that the vertical incision, close to the middle line, is ample and usually gives very satisfactory exposure.

*Pancreatitis.* Of the 6 cases surviving operation all reported as in a satisfactory condition of health. The three deaths were very severe cases, two dying within a few hours after an exploratory operation.

Ductless Glands and Spleen.—*Exophthalmic goitre.* There were two deaths following ligation of a single artery under local anæsthesia. Both were severe cases which had grown steadily worse under prolonged medical treatment. The surviving cases showed, on the whole, fairly good results, certainly about as good as one can ever expect to get following operation.

Herniæ.—*Inguinal hernia, strangulated* (41 operations; 6 deaths). Of these six deaths, three cases required intestinal resection, two were complicated by pneumonia, and one case was a poor operative risk, a man seventy years of age. The ages of these cases were thirty-eight years, thirty-nine years, fifty-four years, sixty years, seventy years and seventy-two years. The two youngest patients died of pneumonia. This is a class of cases, especially in an elderly individual, where a two-stage operation has given in many cases good results. The first operation, done under local anæsthesia, is limited to overcoming the obstruction, usually very easy, or remedying the damage to the gut by an appropriate resection. The second stage for the repair of the hernia is done a few days later, usually under a general anæsthetic, when the patient has recovered from the shock and disturbance of his original condition.

*Umbilical and ventral herniæ.* Both radical cure and operation for strangulation, 87 cases, 74 operations, 12 deaths. Seemingly this mortality is too high, but it must be remembered that a large proportion of these people are quite unsuitable for operation, many of them being stout elderly women with degeneration of the viscera and changes in the blood-vessels. Operation for radical cure was seldom done except in the face of a threatening condition or the patient's refusing to suffer the discomfort of a permanently irreducible hernia. In the strangulated conditions the operation is always prolonged and difficult and often requires intestinal resection.

Infective Diseases.—*Tuberculosis of digestive system.* Peritoneum, 18 original cases, 3 deaths.

Report on 9 cases: 1 case died two weeks after leaving hospital.

| Date of operation | Last report |
|---|---|
| June, 1918 | May, 1919. Gained 13 pounds. No symptoms. |
| Apr. 9, 1917 | May 22, 1917. Recurrence of condition. Sent to country. |
| June 5, 1918 | Oct. 10, 1918. Feels much better. Gained 3 to 5 pounds. Still has abdominal sinus and free discharge. |

| Date of operation | Last report |
|---|---|
| July 19, 1917 | Nov. 4, 1918. Fat and well. Complains of pain in right lower quadrant and vague symptoms. |
| Nov. 22, 1914 | Mar. 15, 1915. Working and well. |
| Aug. 6, 1915 | Nov. 29, 1915. Patient has gone to Germany. In good health. |
| Aug. 25, 1915 | Feb. 13, 1919. Marked improvement. Abdomen soft, no fluid. No masses felt. Gained in weight. |
| Oct., 1915. No operation | Jan., 1916. Looks very bad. |

Cases found under those returning for second operation: Five cases—1 death in hospital; 1 case 21 days after leaving hospital; 1 case not found. Report of other two: Operation, September 24, 1917. Note, December 31, 1917. General condition markedly improved. Still has an open granulating wound, discharging some pus. Operation for tuberculous kidney October 4, 1915. Operation for tuberculosis of peritoneum January, 1917. January 5, 1919: Absolutely all right.

Reproductive Organs.—*Acute salpingitis.* On the whole, we do not favor operations in the acute stages as convalescence is rather more stormy and the risk somewhat greater. Operation has more often been resorted to when the patients failed, under observation, to show speedy signs of improvement. A certain number of cases have wisely been operated on at this stage owing to the real difficulty sometimes encountered in differentiating between acute right salpingitis and appendicitis, and we prefer to take no chances where such a doubt exists.

*Prolapse, retroflexion, retroversion, lacerated cervix and relaxed pelvic floor.* While the results on the whole are satisfactory, we are seeking constantly to improve our methods, especially in the very extreme cases of prolapse of the third degree. It is not our custom to operate on retroversion, simply on the anatomical finding, but to relieve definite symptoms. The repair of laceration of the cervix gave good results.

GROUP III

Digestive System.—*Ulcer of stomach and duodenum.* The results in this class of cases were unsatisfactory as regards operative mortality, 8.5 per cent., which is rather high, although the more recent work has shown marked improvement in that direction. They are, of course, unselected cases and many of them present advanced conditions, making operative procedures complicated and difficult. As regards functional results, on the whole, they are fair. The best results have been obtained in the well-defined, duodenal ulcers, treated by gastro-enterostomy without any other operative procedure. A few cases had some form of blocking of the pylorus added to the gastro-enterostomy. On the whole, these cases did not do so well and this procedure has been abandoned by me. More recently we have had the benefits of better and more accurate anteoperative observation and diagnosis, such as fluoroscopic examination (by Dr. A. L. Holland) with resulting benefits to our results in every way.

*Ulcer of stomach and duodenum, perforating.* The results are two-fold: the operative mortality is too high (10 deaths out of 39 operations),

but the after-results have been very good, no case being recorded as unsatisfactory and the great bulk of patients have shown marked improvement in health. Gastro-enterostomy at the time of the original operation has only very exceptionally been performed. None of the cases here recorded has undergone it subsequently. The mortality of the perforating ulcer of the stomach is almost entirely a question of time, and the following table simply serves to demonstrate this fact. It will be noted that only one case which was operated on less than twenty-four hours after the perforation occurred died.

TIME ELAPSING BETWEEN PERFORATION AND OPERATION
(Report on 39 cases of perforating ulcer of stomach and duodenum)

1 *Deaths* ..... 10
- Forty-eight hours (2)
- Forty-six hours
- Thirty-six hours
- Twenty-four hours (3)
- Twelve hours
- One patient ill ten days.
- One too ill to give detailed history. Had apparently been ill two weeks.

2. *Still living* ..... 29
- One and three-quarter hours
- Between 2 and 3 hours (2)
- Between 3 and 4 hours (5)
- Four hours (2)
- Five hours (6)
- Seven hours
- Eight hours (3)
- Nine and three-quarter hours
- Seventeen hours
- Twenty-four hours (4)
- Three days
- Five days
- Ten days. Patient operated on five days after admission for abdominal abscess; five days later for perforating ulcer. His illness had been of two weeks' duration. Operation for ulcer ten days after admission.

*Cirrhosis of liver,* 5 operations, 3 deaths. In general our impression has been that the results from omentopexy for cirrhosis of the liver are usually bad. Most of the cases are exceedingly poor operative risks with marked renal disease who react very unfavorably to operative procedures. We believe that only a very favorable case should be considered for operation.

*Chronic appendicitis,*[9] 552 operations with 3 deaths. As the number of unsatisfactory cases is quite large a very exhaustive investigation of the subject will be published by me soon. The number of unsatisfactory cases, 30 per cent., is somewhat exaggerated, as we have definite reasons for believing that in the 139 non-investigated cases we probably had the best results. We may say in general that the results were best in the

[9] This group will be the subject of a special paper.

male, in patients with definite history of previous attacks, in cases presenting well marked pain over the site of the appendix as the principal symptoms. Also in patients whose general intelligence and knowledge of the English language allowed them to give satisfactory histories. In the thoroughly satisfactory cases the appendix is definitely noted as obviously pathological in 86 per cent., while the proportion diminishes as the results become unsatisfactory. Of recent years all operations have been conducted as exploratory laparotomies; that is, the small "interval" incisions have been abandoned. Of our 246 excellent cases only 6 were readmitted, while the 100 unsatisfactory yielded 26 readmissions.

Infective Diseases.—*Typhoid fever with perforation.* All cases died, although it is fair to believe that in at least two cases the patients died of the typhoid fever and not of the sequelæ of the perforation or operation. The operation is, for the most part, done under local anæsthesia with the help of generous doses of morphine. Typhoid fever is not coming to operation any earlier nowadays because much time is lost in making blood examinations, which in the presence of the customary leucopænia are a waste of time.

*Lymphadenitis, tuberculous.* This is one of the most unsatisfactory problems. The class of cases chosen is usually those in whom operation could not be avoided; that is, with established or threatened suppuration. Twenty-two of these patients required subsequent operations for the removal of recurrent nodes, and it will be noted that no case was described as excellent. It must, however, be admitted that the classification is a little too severe, as a failure to record a case as excellent is often based on the presence of palpable lymph-nodes in the neck, which are practically always present in the neighborhood of the operative field. So far as feasible other remedial measures were effected—removal of diseased tonsils, care of the teeth, and sojourn in the country—but, of course, in only a limited number.

Reproductive Organs (Male).—*Hypertrophy of prostate.* The mortality is higher in these ward cases (4 deaths after removal of the prostate, 1 death after drainage under local anæsthesia) and does not represent the true status of prostatic surgery. Here again we have the neglected terminal stages in which we are forced to resort to some form of intervention. Our experience in private work, with well selected cases, is much more satisfactory. The removal in all cases was by the suprapubic method to which we are now committed. However, the results of these operations were, on the whole, quite good.

Tumors (Malignant).—This is the saddest part of our study. The tables speak for themselves and require little comment. However, fortunately, this study does not quite fairly represent the cancer situation, as this entire paper is based on the admissions to the wards, who are chiefly neglected, hopeless cases. Results in private work are better, but not sufficiently so to make us optimistic. Moreover, the cancer situation

has been complicated by the introduction of various therapeutic measures, some holding out some legitimate hope for their usefulness, others of the fake or "catch penny" sort. These result in confusion to the profession and deception to the public, and the pitiful cancer sufferer is made the victim, as he does not get a square deal.

An attempt has been made to analyze the opinions that cancer patients receive prior to their admission to the hospital. These have been collected by Doctor Farr in a paper entitled "Delay in the Treatment of Cancer." [10]

It will be noted that none of these cases is recorded as excellent. We do not feel that we can so classify them, owing to the possibility of a recurrence. We have, therefore, divided them into two groups—satisfactory (free from recurrence) and unsatisfactory (recurrence).

*Carcinoma of the breast.* In general our follow-up report of breast carcinoma shows that recurrence is much more frequent than one would believe from the literature. We believe that a patient should be in good condition six years after operation to count a case as cured. As our series only goes back six years we believe that not enough time has elapsed for us to draw definite conclusions. In our study of breast cases, we believe that cases come too late for operation and that progress must be made towards earlier recognition and earlier operation.

SUMMARY OF CARCINOMA CASES

(Including carcinoma, adenocarcinoma and epithelioma)

| | | |
|---|---|---|
| Number of cases | | 259 |
| Number of known deaths | | 169 |
| Number of cases living | | 41 |
| (Ten of these unsatisfactory) | | |
| Unknown | | 49 |
| *Number of operative cases* | | 202 |
| A. Number of deaths | 130 | |
| In hospital | 47 | |
| At home | 83 | |
| B. Satisfactory results | 29 | |
| C. Unsatisfactory results | 8 | |
| D. Unknown | 35 | |
| Of this number 20 were followed in part (12 satisfactory, 8 unsatisfactory) | | |
| E. No specimen removed | 15 | |
| Number of cases not operated upon | | 57 |
| A. Number of deaths | 39 | |
| In hospital | 5 | |
| At home | 34 | |
| B. Satisfactory (dubious diagnosis) | 2 | |
| C. Unsatisfactory | 2 | |
| D. Unknown | 14 | |
| Of this number 2 cases were followed in part, both being unsatisfactory. | | |
| Total number of cases | | 259 |

[10] American Journal of the Medical Sciences, January, 1919.

REPORT OF CARCINOMA CASES THAT ARE STILL LIVING

| Diagnosis | Date of operation | Date of last report | Resulting condition |
|---|---|---|---|
| Breast | Nov., 1913 | Dec., 1918 | Satisfactory |
| Breast | Mar., 1914 | July, 1918 | Satisfactory |
| Breast | Aug., 1914 | Sept., 1918 | Unsatisfactory (recurrence) |
| Stomach* | Mar., 1914 | Mar., 1919 | Satisfactory |
| Stomach | July, 1914 | Jan., 1919 | Satisfactory |
| | Operation refused | | |
| Face | Jan., 1914 | Jan., 1919 | Satisfactory |
| Lip | May, 1914 | Apr., 1919 | Satisfactory |
| Tongue | Sept., 1914 | Feb., 1919 | Satisfactory |
| Appendix | Feb., 1915 | Mar., 1919 | Satisfactory |
| Breast | July, 1915 | Apr., 1919 | Satisfactory |
| Breast | Mar., 1915 | Mar., 1919 | Satisfactory |
| Stomach* | Nov., 1915 | Feb., 1919 | Satisfactory |
| Face | Nov., 1915 | Jan., 1919 | Satisfactory |
| Breast | Jan., 1916 | Dec., 1918 | Satisfactory |
| Breast | Mar., 1916 | Jan., 1919 | Satisfactory |
| Breast | Aug., 1916 | Feb., 1919 | Satisfactory |
| Stomach* | Nov., 1916 | Sept., 1918 | Satisfactory |
| Uterus | Jan., 1916 | Feb., 1919 | Unsatisfactory (recurrence) |
| Uterus | Apr., 1916 | Apr., 1919 | Unsatisfactory (recurrence) |
| Lip | Mar., 1916 | Apr., 1919 | Satisfactory |
| Breast | Feb., 1917 | Feb., 1919 | Unsatisfactory (recurrence) |
| Breast | Apr., 1917 | Jan., 1919 | Satisfactory |
| Breast | June, 1917 | Mar., 1919 | Unsatisfactory (recurrence) |
| Breast | Feb., 1917 | Feb., 1919 | Satisfactory |
| Breast | June, 1917 | Mar., 1919 | Unsatisfactory (recurrence) |
| Lymph nodes | June, 1917 | Oct., 1919 | Satisfactory |
| Rectum | June, 1917 | Mar., 1919 | Satisfactory |
| Intestines | Oct., 1917 | Apr., 1919 | Satisfactory |
| | Operation refused | | |
| Uterus | Aug., 1917 | May, 1919 | Satisfactory |
| Bladder | Oct., 1918 | Mar., 1919 | Satisfactory |
| Bladder | Mar., 1918 | Apr., 1919 | Satisfactory |
| Breast | Oct., 1918 | Mar., 1919 | Satisfactory |
| Breast | Aug., 1918 | Apr., 1919 | Unsatisfactory (recurrence) |
| Breast | May, 1918 | Mar., 1919 | Satisfactory |
| Larynx | Feb., 1918 | Apr., 1919 | Satisfactory |
| Lymph nodes | Aug., 1918 | Jan., 1919 | Satisfactory |
| Intestines | Oct., 1918 | Feb., 1919 | Unsatisfactory (recurrence) |
| | Operation refused | | |
| Uterus | Dec., 1918 | Apr., 1919 | Unsatisfactory (recurrence) |
| Uterus | Mar., 1918 | Feb., 1919 | Satisfactory |
| Uterus | Mar., 1918 | Nov., 1918 | Satisfactory |
| Lip | Feb., 1918 | Apr., 1919 | Unsatisfactory (recurrence) |

* Diagnosis probably wrong—no specimen.

REPORT ON "UNKNOWN RESULTS"

Number of unknown cases ..... 49
(Of this number 14 had no operation.)
Cases having no note ..... 27
Cases followed in part ..... 22

| Diagnosis | Date of operation | Last note |
|---|---|---|
| Breast | Sept., 1913 | June, 1914: Satisfactory |
| Breast | Mar., 1913 | No note |
| | (No operation) | |
| Intestines | Nov., 1913 | July, 1916: Satisfactory |
| Maxilla | Apr., 1913 | No note |
| Fallopian tubes | June, 1913 | No note |
| Stomach | Feb., 1913 | No note |
| | (No operation) | |
| Uterus | July, 1913 | No note |
| | (No operation) | |
| Omentum | Mar., 1913 | No note |
| Breast | June, 1914 | Mar., 1917: Satisfactory |
| Breast | May, 1914 | No note |
| Intestines | May, 1914 | Oct., 1914: Losing strength rapidly. In bed all the time |
| Intestines | Apr., 1914 | Aug., 1914: Slightly improved |
| Lymph nodes | Nov., 1914 | Dec., 1915: Slightly improved |
| Uterus | Aug., 1914 | No note |
| | (No operation) | |
| Uterus | Aug., 1914 | No note |
| Ovary | Feb., 1914 | No note |
| Lip | Dec., 1914 | No note |
| Lip | Feb., 1914 | No note |
| Lip | Jan., 1914 | July, 1916: Satisfactory |
| Penis | Jan., 1914 | Jan., 1915: Satisfactory |
| Breast | Oct., 1915 | Feb., 1916: Satisfactory |
| Bladder | Aug., 1915 | Dec., 1915: Unimproved |
| Intestines | Sept., 1915 | No note |
| Prostate | Apr., 1915 | No note |
| Stomach | May, 1915 | No note |
| Stomach | May, 1915 | June, 1915: Feels better; has returned to work |
| Stomach | May, 1915 | No note |
| Uterus | Oct., 1915 | Jan., 1916: Living on coal barge |
| Lip | Aug., 1915 | Feb., 1916: Satisfactory |
| Breast | Aug., 1916 | Apr., 1918: Losing ground rapidly |
| | (No operation) | |
| Œsophagus | July, 1916 | July, 1917: Unimproved |
| Rectum | Nov., 1916 | No note |
| | (No operation) | |
| Stomach | Dec., 1916 | Jan., 1917: Return of symptoms |
| Face | Jan., 1916 | Dec., 1916: Satisfactory |
| Vulva | June, 1916 | Nov., 1916: Marked recurrence |
| Breast | June, 1917 | Nov., 1917: Satisfactory. |
| Breast | June, 1917 | Apr., 1918: Extensive recurrence |

REPORT ON "UNKNOWN RESULTS"—*Continued*

| Diagnosis | Date of operation | Last note |
|---|---|---|
| Intestines | Mar., 1917 | No note |
| Intestines | Aug., 1917 | No note |
| | (No operation) | No note |
| Prostate | Dec., 1917 | |
| | (No operation) | No note |
| Rectum | Jan., 1917 | |
| | (No operation) | No note |
| Breast | Mar., 1918 | |
| Intestines | Aug., 1918 | No note |
| | (No operation) | |
| Intestines | July, 1918 | No note |
| | (No operation) | |
| Prostate | Oct., 1918 | No note |
| | (No operation) | |
| Stomach | Mar., 1918 | |
| Thyroid | Aug., 1918 | |
| | (No operation) | Nov., 1918: Satisfactory |
| Ovary | Aug., 1918 | |
| Tongue | Mar., 1918 | |
| | (No operation) | Nov., 1918: Very ill |

The educational value of the information obtained by a study of end results has been particularly impressed on the whole staff as time goes on. It was not long before several surprising factors became apparent, and we were able to substitute definite data for vague impressions. In several instances it came as a shock that we were getting poor or bad results of which we were in blissful ignorance, and were stimulated to improve our work with beneficial results. We have a weekly conference of the whole staff which includes a report of the follow-up work of the previous week and, in addition, quarterly and annual reports so that all members of the staff are constantly in touch with the situation.

In view of our enforced revision of judgment concerning our end results obtained by the follow-up system, we feel a certain reluctance to accept statements on such matters unless there is evidence that a systematic effort is made to check up such results.

The accompanying tables give the details of the results obtained:

REPORT OF FOLLOW-UP WORK FROM FEBRUARY, 1913, TO DECEMBER, 1918, INCLUSIVE

| Diagnosis | No. of cases | No. of deaths | No. of operations | Readmitted | 2nd operation | To return | Reported | Excellent | Satisfactory | Unsatisfactory | Died at home |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Congenital Abnormalities and Malformations:* | | | | | | | | | | | |
| Malformations | 87 | 5(1)* | 73 | Tonsils | 1 | 57 | 45 | 24 | 17 | 4 | |
| | | | | Neurasthenia | 0 | | | | | | |
| | | | | Hare lip | Died | | | | | | |
| *The Blood:* | | | | | | | | | | | |
| Streptococcus blood infection | 1 | 0 | 0 | | 0 | | | | | | |
| *Bones and Cartilages:* | | | | | | | | | | | |
| Abscess of bone | 2 | 0 | 2 | | ... | 2 | 0 | | | | |
| Faulty union | 22 | 0 | 22 | Faulty union (4 cases) | 2 | 19 | 17 | 2 | 13 | 2 | |
| | | | | Fractured femur | Died | | | | | | |
| Necrosis | 3 | 0 | 3 | Abscess | 1 | 2 | 2 | ... | 2 | | |
| Osteomyelitis | 104 | 9 | 93 | Osteomyelitis (11 cases) | 8 | 69 | 50 | 10 | 29 | 9 | 2 |
| Ostitis deformans | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Periostitis | 5 | 0 | 2 | | ... | 3 | 2 | ... | 1 | ... | 1 |
| *Bursæ:* | | | | | | | | | | | |
| Bursitis | 26 | 0 | 20 | Bursitis | 1 | 19 | 14 | 8 | 5 | 1 | |
| | | | | Ulcer-leg | 1 | | | | | | |
| *The Circulatory System:* | | | | | | | | | | | |
| Aneurysm | 8 | 1 | 8 | Aneurism | 1 | 6 | 3 | ... | 2 | 1 | |
| Arteriosclerosis | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Cardiac valvular disease | 2 | 0 | 0 | | ... | 0 | | | | | |
| Endarteritis obliterans | 8 | 0 | 5 | Endarteritis | 3 | 8 | 6 | 1 | 3 | 1 | 1 |
| Myocarditis | 1 | 0 | 0 | | ... | 0 | | | | | |
| Thrombosis | 1 | 1 | 1 | | | | | | | | |
| Varicose veins | 49 | 0 | 44 | Varicose veins | 1 | 42 | 32 | 12 | 18 | 2 | |
| *Digestive System:* | | | | | | | | | | | |
| Appendicitis, acute | 789 | 36(2) | 782 | Fecal fistula | 3 | 623 | 502 | 313 | 182 | 5 | 2 |
| | | | | Ventral hernia (11 cases) | 10 | | | | | | |
| | | | | Salpingitis | 3 | | | | | | |
| | | | | Tonsils (3 cases) | 2 | | | | | | |
| | | | | Abdominal sinus | 1 | | | | | | |
| | | | | Cystitis (1) | 0 | | | | | | |
| | | | | P. O. adhesions (2) | 0 | | | | | | |
| | | | | Cholelithiasis | 0 | | | | | | |
| | | | | Constipation | 0 | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Abscess of omentum | 1 | | | | | | |
| | | | | Adenoma of thyroid | 1 | | | | | | |
| | | | | Abscess of leg | 1 | | | | | | |
| | | | | Actinomycosis of colon (1) | Died | | | | | | |
| | | | | Foreign body in abdominal sinus | 1 | | | | | | |
| | | | | Pelvic abscess | 1 | | | | | | |
| | | | | Inguinal hernia | 1 | | | | | | |
| Appendicitis, chronic | 586 | 3 | 552 | Cystitis (1) | 0 | 553 | 414 | 246 | 67 | 100 | 1 |
| | | | | P. O. adhesions (7 cases) | 5 | | | | | | |
| | | | | Anteflexion of uterus | 1 | | | | | | |
| | | | | Tonsils | 1 | | | | | | |
| | | | | Hemorrhoids | 2 | | | | | | |
| | | | | Malformation of spinal column | 1 | | | | | | |
| | | | | Chronic myositis (1) | 0 | | | | | | |
| | | | | P. O. wound | 1 | | | | | | |
| | | | | Constipation (2) | 0 | | | | | | |
| | | | | Hysteria (1) | 0 | | | | | | |
| | | | | Gastroptosis | 2 | | | | | | |
| | | | | Lacerated pelvic floor | 1 | | | | | | |
| | | | | Fissure of anus | 1 | | | | | | |
| | | | | Cholecystitis | 1 | | | | | | |
| | | | | Contusion of breast | 0 | | | | | | |
| | | | | Gastric ulcer (2) | 0 | | | | | | |
| | | | | Furunculosis | 0 | | | | | | |
| | | | | Foreign body in abdominal wall | 1 | | | | | | |
| | | | | Ventral hernia | 1 | | | | | | |
| | | | | Inguinal hernia | 1 | | | | | | |
| | | | | Circumcision | 1 | | | | | | |
| | | | | Cystoma of ovary | 1 | | | | | | |
| | | | | Pyonephrosis | 1 | | | | | | |
| | | | | Tubercular intestine | Died | | | | | | |
| Colitis | 7 | 2 | 2 | Stricture of urethra | 1 | 3 | 3 | ... | 1 | 2 | |
| Constipation | 48 | 0 | 6 | Chronic appendix | 2 | 4 | 4 | ... | 2 | 2 | |
| Diverticulitis | 2 | 0 | 2 | ..... | ... | 1 | 1 | ... | ... | ... | 1 |
| Fecal fistula | 2 | 0 | 2 | Abdominal sinus | 1 | 2 | 0 | | | | |
| | | | | Ventral hernia | 1 | | | | | | |
| Dilatation of cæcum | 1 | 0 | 1 | ..... | ... | 1 | 1 | ... | 1 | | |
| Gastro-enteritis | 5 | 0 | 0 | ..... | ... | 0 | | | | | |
| Mesenteric thrombosis | 6 | 6(1) | 6 | | | | | | | | |
| Intestinal obstruction | 38 | 17(2) | 36 | Ventral hernia | 1 | 17 | 14 | 7 | 5 | 2 | |
| Intestinal hemorrhage | 1 | 0 | 1 | ..... | ... | 1 | 1 | 1 | | | |

REPORT OF FOLLOW-UP WORK FROM FEBRUARY, 1913, TO DECEMBER, 1918, INCLUSIVE.—*Continued*

| Diagnosis | No. of cases | No. of deaths | No. of operations | Readmitted | 2nd operation | To return | Reported | Excellent | Satisfactory | Unsatisfactory | Died at home |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Digestive System:* Continued | | | | | | | | | | | |
| Visceroptosis | 14 | 0 | 2 | | ... | 2 | 2 | ... | 2 | | |
| Ulcer of cæcum | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Stricture of intestine | 1 | 1 | 1 | | | | | | | | |
| Abscess of liver | 6 | 0 | 6 | Abscess-liver | 1 | 4 | 3 | 2 | ... | 1 | |
| Cirrhosis of liver | 7 | 3 | 5 | | ... | 4 | 4 | ... | 1 | ... | 3 |
| Cholelithiasis and cholecystitis | 214 | 14(2) | 179 | Abscess of muscle | 1 | 166 | 142 | 48 | 80 | 12 | 2 |
| | | | | Stenosis of gall bladder | Died | | | | | | |
| | | | | P. O. adhesions | 4 | | | | | | |
| | | | | Constipation | 0 | | | | | | |
| | | | | Ventral hernia | 2 | | | | | | |
| | | | | Carcinoma of gall bladder | Died | | | | | | |
| | | | | Fibromyoma of uterus | 1 | | | | | | |
| | | | | Tubercular vertebra | 0 | | | | | | |
| | | | | Cholelithiasis | Died | | | | | | |
| | | | | Strangulated inguinal hernia | 1 | | | | | | |
| Pelvic abscess | 6 | 2(1) | 4 | | ... | 3 | 2 | ... | 1 | 1 | |
| Adhesions of peritoneum | 36 | 1 | 25 | Ventral hernia | 1 | 24 | 23 | 3 | 13 | 7 | |
| Peritonitis | 18 | 10(2) | 16 | | ... | 7 | 5 | 2 | 2 | 1 | |
| Tonsils and adenoids | 561 | 1 | 559 | Circumcision | 1 | 281 | 227 | 173 | 53 | ... | 1 |
| | | | | Pulmonary tuberculosis | 0 | | | | | | |
| | | | | Tubercular hip | 1 | | | | | | |
| Abscess of pharynx | 3 | 1 | 2 | | ... | 2 | 1 | 1 | | | |
| Foreign body in œsophagus | 3 | 0 | 2 | | ... | 2 | 2 | 1 | ... | ... | 1 |
| Stricture of œsophagus | 1 | 0 | 0 | | ... | 1 | 1 | ... | 1 | | |
| Ulcer of mouth | 2 | 0 | 2 | | ... | 2 | 2 | ... | 2 | | |
| Alveolar abscess | 13 | 0 | 11 | | ... | 2 | 2 | ... | 2 | | |
| Pancreatitis | 9 | 3 | 9 | | ... | 6 | 6 | 4 | 2 | | |
| Abscess about rectum and fistula in ano | 98 | .... | 97 | Axillary abscess | 1 | 61 | 46 | 14 | 26 | 6 | |
| | | | | Abscess-rectum | 2 | | | | | | |
| | | | | Structure urethra | 1 | | | | | | |
| | | | | Fistula in ano | 7 | | | | | | |
| | | | | Inguinal hernia | 1 | | | | | | |
| | | | | Hemorrhoids | 1 | | | | | | |
| | | | | Lacerated tendons | 1 | | | | | | |
| | | | | Stricture of rectum | 1 | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fissure of anus | 4 | 0 | 4 | ... | ... | 4 | 3 | 3 | | | |
| Hemorrhoids | 191 | 0 | 184 | Duodenal ulcer | Died | 114 | 73 | 25 | 45 | 3 | |
| | | | | Gastric ulcer | 1 | | | | | | |
| | | | | Teratoma | 1 | | | | | | |
| | | | | Fistula | 1 | | | | | | |
| | | | | Pyelitis | 0 | | | | | | |
| Prolapse of rectum | 3 | 0 | 3 | Prolapse of rectum | 0 | 2 | 2 | ... | 1 | 1 | |
| Proctitis | 1 | 0 | 1 | ... | ... | 0 | | | | | |
| Stricture of rectum | 4 | 0 | 2 | ... | ... | 3 | 2 | ... | 2 | | |
| Ulcer of rectum | 2 | 0 | 1 | ... | ... | 1 | 1 | 1 | | | |
| Acute dilatation of stomach | 1 | 0 | 1 | ... | ... | 1 | 1 | ... | 1 | | |
| Gastritis | 4 | 0 | 0 | ... | ... | 0 | | | | | |
| Foreign body in stomach | 1 | 0 | 0 | ... | ... | 0 | | | | | |
| Hypochlorhydria | 2 | 0 | 1 | ... | ... | 0 | | | | | |
| Pyloric spasm | 2 | 0 | 2 | ... | ... | 2 | 1 | ... | ... | 1 | |
| Stenosis of pylorus | 1 | 1 | 1 | | | | | | | | |
| Ulcer of stomach and duodenum | 93 | 7(1) | 70 | Perf. ulcer | Died | 62 | 55 | 28 | 22 | 4 | 1 |
| | | | | Ulcer—stomach (2) | 0 | | | | | | |
| | | | | Carcinoma of stomach | Died | | | | | | |
| | | | | Revision of gastro-enterostomy | 1 | | | | | | |
| | | | | Salpingitis | 1 | | | | | | |
| | | | | Adhesions | 1 | | | | | | |
| | | | | Neurasthenia | 0 | | | | | | |
| Ulcer of stomach, perforating | 40 | 11(1) | 39 | ... | ... | 29 | 26 | 10 | 16 | | |
| *Ductless Glands and Spleen:* | | | | | | | | | | | |
| Exophthalmic goitre | 12 | 2 | 9 | Goitre | 1 | 8 | 5 | 1 | 3 | 1 | |
| Simple cystic goitre | 12 | 0 | 9 | ... | ... | 8 | 4 | 2 | 2 | | |
| Suppurative thyroiditis | 1 | 0 | 1 | ... | ... | 1 | 1 | ... | 1 | | |
| Diseases of spleen | 11 | 1 | 9 | Banti's (1) | Died | 6 | 6 | 4 | 1 | ... | 1 |
| | | | | Splenomegaly | Died | | | | | | |
| *The Ear:* | | | | | | | | | | | |
| Otitis media and mastoiditis | 16 | 0 | 8 | ... | ... | 13 | 8 | 4 | 4 | | |
| *The Eye:* | | | | | | | | | | | |
| Ulcer of cornea | 1 | 0 | 0 | ... | ... | 1 | 0 | | | | |
| *Herniæ:* | | | | | | | | | | | |
| Epigastric | 4 | 0 | 4 | Ventral | 1 | 4 | 3 | ... | 2 | 1 | |
| Femoral | 54 | 1 | 53 | Inguinal hernia | 2 | 46 | 40 | 27 | 10 | 3 | |
| | | | | Relaxed pelvic floor | 1 | | | | | | |
| | | | | Prolapse of uterus | 1 | | | | | | |

REPORT OF FOLLOW-UP WORK FROM FEBRUARY, 1913, TO DECEMBER, 1918, INCLUSIVE.—*Continued*

| Diagnosis | No. of cases | No. of deaths | No. of operations | Readmitted | 2nd operation | To return | Reported | Excellent | Satisfactory | Unsatisfactory | Died at home |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Herniæ*: Continued | | | | | | | | | | | |
| Femoral, strangulated | 11 | 1 | 11 | ..... | ... | 9 | 9 | 5 | 4 | | |
| Inguinal | 872 | 2 | 849 | Hernia, opposite side | 10 | 780 | 539 | 319 | 209 | 11 | |
| | | | | Recurrence | 9 | | | | | | |
| | | | | Cellulitis of wound (2) | 1 | | | | | | |
| | | | | Tonsils | 2 | | | | | | |
| | | | | Hydrocele | 2 | | | | | | |
| | | | | Endothelioma of submaxillary nodes | 0 | | | | | | |
| | | | | Varicose veins | 1 | | | | | | |
| | | | | Carcinoma of bladder | 1 | | | | | | |
| | | | | Hemorrhoids | 2 | | | | | | |
| | | | | Acute appendicitis | 3 | | | | | | |
| | | | | Congenital malformation of testicle | 0 | | | | | | |
| | | | | Tubercular vertebra | 1 | | | | | | |
| | | | | Inguinal abscess | 1 | | | | | | |
| | | | | Femoral hernia | 1 | | | | | | |
| Inguinal, strangulated | 41 | 6 | 41 | Tubercular peritoneum | 2 | 34 | 25 | 16 | 7 | 1 | 1 |
| | | | | Strangulated hernia, opposite side | 1 | | | | | | |
| Umbilical | 22 | 2 | 21 | ..... | 0 | 17 | 14 | 4 | 9 | 1 | |
| Umbilical, strangulated | 9 | 5(1) | 9 | Fibroid uterus | 0 | 4 | 3 | ... | 2 | ... | 1 |
| | | | | Inguinal hernia | 1 | | | | | | |
| Ventral | 49 | 2 | 39 | Salpingitis | 2 | 33 | 26 | 17 | 8 | 1 | |
| | | | | Tubercular vertebra | 0 | | | | | | |
| | | | | Hemorrhoids | 1 | | | | | | |
| Ventral, strangulated | 7 | 3(1) | 5 | Intestinal obstruction | Died | 2 | 1 | ... | 1 | | |
| *Infective Diseases:* | | | | | | | | | | | |
| Abscess | 115 | 4 | 110 | Abscess | 4 | 73 | 52 | 20 | 25 | 5 | 2 |
| | | | | Chronic appendix | 1 | | | | | | |
| | | | | Tubercular vertebra | 0 | | | | | | |
| | | | | Tubercular peritonitis | Died | | | | | | |
| Carbuncle | 21 | 2 | 21 | ..... | ... | 8 | 7 | 3 | 4 | | |
| Cellulitis | 100 | 5 | 90 | P. O. hemorrhage | 1 | 71 | 53 | 13 | 34 | 6 | |
| | | | | Contracture | 1 | | | | | | |
| | | | | Abscess | 1 | | | | | | |
| Erysipelas | 2 | 0 | 0 | ..... | 0 | | | | | | |
| Furunculosis | 5 | 0 | 5 | ..... | ... | 3 | 3 | 1 | 2 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Glanders | 1 | 1 | 1 | | | | | | | | |
| Gonococcus infection | 3 | 0 | 2 | | ... | 1 | 1 | ... | 1 | | |
| Jaundice | 1 | 0 | 0 | | ... | 0 | | | | | |
| Rheumatic fever | 3 | 0 | 0 | | ... | 2 | 2 | ... | 2 | | |
| Syphilis | 29 | 0 | 13 | Syphilis | 0 | 20 | 10 | 2 | 7 | ... | 1 |
| Tetanus | 3 | 0 | 2 | Osteomyelitis | 1 | 3 | 3 | 1 | 2 | | |
| Tuberculosis of bones | 41 | 0 | 36 | Pulmonary tuberculosis | 0 | 31 | 25 | 1 | 17 | 7 | |
| | | | | Tubercular costal cartilage | 1 | | | | | | |
| | | | | Tubercular bones | 1 | | | | | | |
| | | | | Tubercular skin | 1 | | | | | | |
| | | | | Chronic endometritis | 1 | | | | | | |
| Bursa | 2 | 0 | 2 | | ... | 1 | 1 | ... | 1 | | |
| Digestive system | 24 | 5 | 18 | Same | 0 | 14 | 10 | ... | 7 | 2 | 1 |
| Joints | 46 | 1(1) | 37 | Same (8) | 7 | 31 | 25 | 1 | 12 | 10 | 2 |
| Muscular system | 7 | 1 | 7 | | ... | 5 | 5 | ... | 4 | 1 | |
| Epididymis | 10 | 0 | 6 | Same | 2 | 6 | 4 | ... | 3 | 1 | |
| Fallopian tubes | 8 | 0 | 8 | Same | 1 | 8 | 6 | ... | 5 | 1 | |
| | | | | Tubercular vertebra | 1 | | | | | | |
| Pulmonary tuberculosis | 18 | 1(1) | 2 | | ... | 4 | 4 | ... | 2 | ... | 2 |
| Skin | 4 | 0 | 2 | | ... | 3 | 3 | 2 | 1 | | |
| Urinary organs (bladder, 1; kidney, 25) | 26 | 0 | 15 | Tubercular peritoneum | 1 | 21 | 18 | 6 | 6 | 3 | 3 |
| | | | | Tubercular properitoneal tissue | 1 | | | | | | |
| | | | | Tubercular kidney | 1 | | | | | | |
| | | | | Tubercular bone | 1 | | | | | | |
| Acute general tuberculosis | 1 | 1(1) | 0 | | | | | | | | |
| Typhoid fever | 2 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Typhoid fever with perforation | 6 | 6 | 6 | | | | | | | | |
| *Joints:* | | | | | | | | | | | |
| Ankylosis | 14 | 0 | 11 | Same | 3 | 9 | 7 | ... | 5 | 2 | |
| Arthritis | 34 | 0 | 24 | Same | 2 | 19 | 12 | 2 | 6 | 4 | |
| | | | | Cellulitis | 1 | | | | | | |
| Coxa vara | 1 | 0 | 0 | | ... | 1 | 1 | ... | ... | 1 | |
| Genu valgum | 8 | 0 | 7 | | ... | 6 | 4 | ... | 3 | ... | 1 |
| Genu varum | 12 | 0 | 6 | | ... | 4 | 4 | ... | 3 | 1 | |
| Hallux valgus | 8 | 0 | 8 | | ... | 8 | 6 | 3 | 2 | 1 | |
| Pes planus | 6 | 0 | 0 | | ... | 5 | 3 | 1 | 2 | | |
| Pes cavus | 1 | 0 | 1 | | ... | 0 | | | | | |
| Talipes | 3 | 0 | 3 | Talipes | 1 | 3 | 3 | 1 | 2 | | |
| *Lymphatic System:* | | | | | | | | | | | |
| Lymphadenitis, simple | 49 | 0 | 40 | Salpingitis | 1 | 22 | 14 | 4 | 9 | 1 | |
| Lymphadenitis, tubercular | 104 | 0 | 100 | Tubercular lymph nodes | 22 | 83 | 66 | ... | 48 | 16 | 2 |

REPORT OF FOLLOW-UP WORK FROM FEBRUARY, 1913, TO DECEMBER, 1918, INCLUSIVE.—*Continued*

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|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lymphatic System:* Continued. | | | | | | | | | | | |
| Lymphadenitis, tubercular | | | | General tuberculosis | 0 | | | | | | |
| | | | | Tonsils | 3 | | | | | | |
| | | | | Osteomyelitis | 1 | | | | | | |
| Elephantiasis | 2 | 1 | 2 | | ... | 1 | 1 | ... | ... | 1 | |
| Hodgkin's | 4 | 0 | 3 | | ... | 3 | 3 | ... | 2 | 1 | |
| *Miscellaneous:* | | | | | | | | | | | |
| Miscellaneous diseases | 57 | 2 | 34 | | ... | 22 | 18 | 4 | 10 | 3 | 1 |
| *Muscles and Tendons:* | | | | | | | | | | | |
| Diseases of muscles and tendons | 20 | 0 | 16 | | ... | 14 | 12 | 9 | 3 | | |
| *Nervous System:* | | | | | | | | | | | |
| Diseases of nervous system | 31 | 4 | 8 | | ... | 5 | 5 | ... | 2 | 3 | |
| *Reproductive Organs (Female):* | | | | | | | | | | | |
| Dysmenorrhœa | 3 | 0 | 1 | Appendicitis, acute | 1 | 2 | 2 | 2 | | | |
| Metrorrhagia | 4 | 0 | 2 | Metrorrhagia | 1 | 3 | 3 | ... | 2 | ... | 1 |
| | | | | Chorio-epithelioma of uterus | 1 | | | | | | |
| | | | | Endometritis | 1 | | | | | | |
| Sterility | 1 | 0 | 0 | | ... | 0 | | | | | |
| Galactocele | 1 | 0 | 1 | | ... | 1 | 0 | | | | |
| Hypertrophy of breast | 1 | 0 | 1 | | ... | 0 | | | | | |
| Mastitis | 44 | 0 | 40 | Same | 4 | 36 | 26 | 19 | 5 | 1 | 1 |
| Pelvic cellulitis | 3 | 1 | 3 | Cystoma ovary | 1 | 2 | 2 | 1 | 1 | | |
| Extra-uterine gestation | 52 | 3(1) | 51 | Endometritis | 1 | 45 | 33 | 18 | 11 | 4 | |
| | | | | Cystoma ovary | 1 | | | | | | |
| | | | | Phlebitis | 0 | | | | | | |
| | | | | Intestinal colic | 0 | | | | | | |
| Hæmatosalpinx | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Oöphoritis | 9 | 0 | 8 | | ... | 7 | 6 | 3 | 2 | 1 | |
| Salpingitis, acute | 47 | 3(1) | 43 | Acute gastritis | 0 | 37 | 27 | 14 | 11 | 2 | |
| | | | | Tubercular peritoneum | 1 | | | | | | |
| | | | | Cystoma ovary | 1 | | | | | | |
| | | | | Ventral hernia | 1 | | | | | | |
| Salpingitis, chronic | 244 | 5 | 211 | Rectovaginal fistula | 0 | 165 | 118 | 39 | 67 | 11 | 1 |
| | | | | Pyelitis | 0 | | | | | | |
| | | | | P. O. adhesions | 1 | | | | | | |
| | | | | Ganglion | 1 | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Ventral hernia (2)** | 1 | | | | | |
| | | | | Intestinal obstruction | Died | | | | | |
| | | | | Ventral hernia | Died | | | | | |
| | | | | **Pelvic peritonitis** | 0 | | | | | |
| | | | | Pelvic abscess | 1 | | | | | |
| | | | | Endotrachelitis | 0 | | | | | |
| | | | | Appendicitis, chronic | 1 | | | | | |
| | | | | Cystoma ovary | 0 | | | | | |
| | | | | Relaxed pelvic floor | 0 | | | | | |
| | | | | Fibromyoma | 1 | | | | | |
| | | | | Salpingitis (2) | 0 | | | | | |
| | | | | Abortion, incomplete | 1 | | | | | |
| Displacement of uterus: | | | | | | | | | | |
| Anteflexion | 14 | 0 | 13 | ..... | ... | 10 | 8 | 2 | 5 | 1 |
| Anteversion | 2 | 0 | 2 | Anteversion | 1 | 2 | 1 | ... | 1 | |
| Prolapse | 26 | 1 | 21 | Abscess vulva | 1 | 19 | 15 | 4 | 8 | 3 |
| | | | | Prolapse | 0 | | | | | |
| | | | | Cystocele | 1 | | | | | |
| Retroflexion | 5 | 0 | 6 | ..... | ... | 4 | 3 | 2 | ... | 1 |
| Retroversion | 64 | 0 | 61 | Salpingitis | 1 | 46 | 33 | 8 | 20 | 5 |
| | | | | Endometritis | 1 | | | | | |
| | | | | Incomplete abortion | 1 | | | | | |
| Endometritis | 127 | 0 | 118 | Cystoma of ovary | 1 | 83 | 48 | 14 | 22 | 12 |
| | | | | Salpingitis (5) | 3 | | | | | |
| | | | | Varicose veins | 1 | | | | | |
| | | | | Extra-uterine | 1 | | | | | |
| Endotrachelitis | 3 | 0 | 2 | Tubercular appendix | 1 | 2 | 2 | ... | ... | 2 |
| Lacerated cervix | 20 | 0 | 15 | Abscess about rectum | 1 | 12 | 11 | 2 | 7 | 2 |
| Stricture of uterine canal | 5 | 0 | 4 | ..... | ... | 4 | 3 | ... | 2 | 1 |
| Abscess of Bartholin's gland | 10 | 0 | 9 | ..... | ... | 5 | 4 | 3 | 1 | |
| Abscess of vulva | 2 | 0 | 2 | ..... | ... | 1 | 0 | | | |
| Atresia of vagina | 1 | 0 | 1 | ..... | ... | 1 | 0 | | | |
| Rectovaginal fistula | 2 | 0 | 1 | ..... | ... | 1 | 0 | | | |
| Uretero vaginal fistula | 1 | 0 | 1 | ..... | ... | 1 | 1 | 1 | | |
| Relaxed pelvic floor | 121 | 2 | 109 | Endotrachelitis | 1 | 92 | 75 | 30 | 37 | 8 |
| | | | | Fibroid uterus | 3 | | | | | |
| | | | | Hæmatoma | 1 | | | | | |
| | | | | Endometritis | 1 | | | | | |
| | | | | Pleurisy | 0 | | | | | |
| | | | | Cystoma | 1 | | | | | |
| | | | | Pyelitis | 0 | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| *Reproductive Organs (Female):* Continued | | | | | | | | | | | |
| | | | | Salpingitis | 1 | | | | | | |
| | | | | Ureteral colic | 0 | | | | | | |
| | | | | Abscess rectum | 1 | | | | | | |
| Vaginitis | 2 | 0 | 0 | ... | ... | 0 | | | | | |
| *Reproductive Organs (Male):* | | | | | | | | | | | |
| Phimosis and redundant prepuce | 73 | 0 | 68 | Tonsils | 2 | 25 | 20 | 18 | 2 | | |
| | | | | Adenitis | 0 | | | | | | |
| Abscess of prostate | 5 | 0 | 4 | ... | ... | 2 | 2 | 1 | ... | 1 | |
| Hypertrophy of prostate | 22 | 5 | 19 | Hydrocele | 1 | 14 | 10 | 3 | 5 | 1 | 1 |
| | | | | Stricture of urethra | 1 | | | | | | |
| | | | | Inguinal hernia | 1 | | | | | | |
| Abscess of scrotum | 2 | 0 | 1 | ... | ... | 0 | | | | | |
| Calculus of prostate | 1 | 0 | 0 | ... | ... | 1 | 0 | | | | |
| Prostatitis | 1 | 0 | 0 | ... | ... | 1 | 0 | | | | |
| Acute orchitis | 1 | 0 | 0 | ... | ... | 0 | | | | | |
| Hydrocele | 65 | 0 | 62 | Hydrocele | 2 | 45 | 31 | 20 | 10 | 1 | |
| | | | | Abscess scrotum | 1 | | | | | | |
| | | | | Tubercular nodes | 1 | | | | | | |
| Varicocele | 79 | 0 | 78 | Cellulitis of scrotum | 1 | 60 | 36 | 18 | 17 | 1 | |
| Spermatocele | 2 | 0 | 2 | ... | ... | 1 | 1 | ... | 1 | | |
| Epididymitis | 9 | 0 | 4 | Epididymitis | ... | 3 | 3 | 2 | 1 | | |
| *Parasites:* | | | | | | | | | | | |
| Entamœbic dysentery | 1 | 0 | 1 | ... | ... | 1 | 1 | 1 | | | |
| Echinococcus cysts liver | 4 | 2 | 4 | ... | ... | 2 | 1 | 1 | | | |
| Spleen | 1 | 0 | 1 | ... | ... | 1 | 1 | ... | 1 | | |
| *Respiratory System:* | | | | | | | | | | | |
| Abscess of lung | 4 | 1 | 4 | Inguinal hernia | 1 | 3 | 2 | 1 | 1 | | |
| Suppurative pleurisy | 96 | 14(1) | 89 | Suppurative pleurisy (7) | 5 | 49 | 45 | 26 | 17 | 1 | 1 |
| | | | | Abscess of lung (2) | 2 | | | | | | |
| | | | | | 1 died | | | | | | |
| | | | | Bronchectasis | 1 | | | | | | |
| Lobar pneumonia | 2 | 2(1) | 1 | | | | | | | | |
| *Nasal Passages and Accessory Sinuses:* | | | | | | | | | | | |
| Sinusitis | 3 | 0 | 3 | ... | ... | 3 | 2 | 1 | 1 | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Skin, Hair and Nails:* | | | | | | | | | | | |
| Cicatrix of skin | 3 | 0 | 3 | | ... | 3 | 2 | ... | 1 | 1 | |
| Callosities | 1 | 0 | 1 | | ... | 0 | | | | | |
| Eczema | 1 | 0 | 0 | | ... | 0 | | | | | |
| Ingrowing nail | 4 | 0 | 3 | | ... | 3 | 3 | 1 | 1 | 1 | |
| Pruritus of scrotum | 1 | 0 | 0 | | ... | 1 | 1 | ... | 1 | | |
| Ulcer | 4 | 0 | 4 | | ... | 4 | 4 | 4 | | | |
| *Tumors (Benign):* | | | | | | | | | | | |
| Angioma | 8 | 0 | 7 | | ... | 5 | 3 | 1 | 2 | | |
| Adenoma | 6 | 0 | 6 | | ... | 6 | 4 | 3 | 1 | | |
| Cystoma of ovary (5 exceptions—thigh, vaginal wall, ulna, jaw and sacral region.) | 67 | 3 | 64 | Fistula in ano | 1 | 56 | 42 | 12 | 25 | 5 | |
| | | | | Cholelithiasis | 1 | | | | | | |
| | | | | Arthritis | 0 | | | | | | |
| | | | | Syphilis | 1 | | | | | | |
| | | | | Calculus ureter | 1 | | | | | | |
| | | | | Endometritis | 1 | | | | | | |
| | | | | Fibromyoma | 1 | | | | | | |
| | | | | Salpingitis | 1 | | | | | | |
| | | | | Abscess | 1 | | | | | | |
| | | | | Cystoma | 1 | | | | | | |
| Chondroma | 2 | 0 | 2 | | ... | 2 | 1 | 1 | | | |
| Fibroma of | | | | | | | | | | | |
| Arm | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Abdominal wall | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Alveolar ridge | 1 | 0 | 1 | | ... | 1 | 0 | | | | |
| About anus | 1 | 0 | 1 | | ... | 0 | | | | | |
| Neck | 3 | 0 | 3 | | ... | 3 | 2 | 7 | 7 | | |
| Skin (keloid) | 2 | 0 | 2 | | ... | 2 | 2 | ... | ... | 2 | |
| Lipoma | 19 | 0 | 19 | Lipoma | 2 | 15 | 10 | 7 | 2 | 1 | |
| Lymphangioma | 1 | 0 | 1 | | ... | 1 | 1 | ... | ... | 1 | |
| Osteoma | 8 | 0 | 6 | Revision of stump | 1 | 6 | 5 | 1 | 3 | 1 | |
| | | | | Osteoma | 1 | | | | | | |
| Papilloma | 11 | 1 | 11 | Papilloma | 0 | 10 | 10 | 5 | 5 | | |
| | | | | Umbilical hernia | 1 | | | | | | |
| Neuroma | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Polyp | 7 | 0 | 7 | Salpingitis | 1 | 2 | 1 | ... | 1 | | |
| Retention cyst | 15 | 0 | 15 | Fistula in ano | 1 | 5 | 3 | 2 | 1 | | |
| | | | | Ostitis media | 0 | | | | | | |
| Teratoma | 9 | 0 | 9 | | ... | 8 | 3 | 1 | 1 | ... | 1 |
| Fibro-adenoma of breast | 18 | 0 | 17 | | ... | 16 | 14 | 12 | 0 | 2 | |
| Fibro-angioma | 2 | 0 | 2 | | ... | 2 | 2 | 1 | 1 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| *Tumors (Benign):* Continued | | | | | | | | | | | |
| Fibromyoma of uterus | 145 | 4 | 133 | Carcinoma of uterus | 1 | 108 | 81 | 34 | 38 | 4 | 5 |
| | | | | Cholecystitis | 1 | | | | | | |
| | | | | Vulvo-vaginal abscess | 1 | | | | | | |
| | | | | Adhesions | 2 | | | | | | |
| | | | | Lacerated pelvic floor | 1 | | | | | | |
| | | | | Constipation | 0 | | | | | | |
| Fibrolipoma | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Lymphoangio-fibrolipoma | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Osteochondroma | 2 | 0 | 2 | | ... | 2 | 2 | 1 | 1 | | |
| Unknown | 3 | 0 | 0 | | ... | 0 | | | | | |
| *Tumors (Malignant):* | | | | | | | | | | | |
| Carcinoma of | | | | | | | | | | | |
| Appendix | 2 | 1 | 2 | | ... | 1 | 1 | ... | 1 | | |
| Bartholin's gland | 1 | 0 | 1 | | ... | 1 | 1 | ... | ... | ... | 1 |
| Bladder | 10 | 2 | 7 | | ... | 8 | 7 | ... | 2 | ... | 5 |
| Breast | 51 | 0 | 48 | Recurrence | Died | 50 | 41 | ... | 12 | 4 | 25 |
| Gall-bladder | 6 | 2 | 5 | | ... | 4 | 4 | ... | ... | ... | 4 |
| Intestines | 33 | 11 | 25 | Recurrence | 1 | 21 | 14 | ... | 1 | 1 | 12 |
| Larynx | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Liver | 6 | 3 | 6 | | ... | 3 | 3 | ... | ... | ... | 3 |
| Lymph nodes | 6 | 0 | 5 | | ... | 6 | 5 | ... | 2 | ... | 3 |
| Maxilla | 3 | 1 | 3 | | ... | 2 | 1 | ... | ... | ... | 1 |
| Œsophagus | 4 | 1 | 4 | | ... | 3 | 2 | ... | ... | ... | 2 |
| Pancreas | 7 | 4(1) | 3 | | ... | 3 | 3 | ... | ... | ... | 3 |
| Peritoneum | 2 | 2 | 2 | | | | | | | | |
| Prostate | 5 | 1 | 2 | | ... | 4 | 1 | ... | ... | ... | 1 |
| Rectum | 11 | 3(1) | 7 | | ... | 8 | 6 | ... | 1 | ... | 5 |
| Stomach | 40 | 11(1) | 30 | Recurrence | Died | 28 | 22 | ... | 4 | ... | 18 |
| Thyroid | 2 | 1(1) | 0 | | ... | 1 | 0 | | | | |
| Fallopian tubes | 3 | 0 | 3 | | ... | 3 | 2 | ... | ... | ... | 2 |
| Uterus | 32 | 1 | 21 | Recurrence | 3 (2 died) | 29 | 25 | ... | 3 | 3 | 19 |
| Ovaries | 5 | 2 | 5 | | ... | 3 | 1 | ... | ... | ... | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Endothelioma of | | | | | | | | | | | |
| Nodes of neck | 3 | 0 | 3 | | ... | 3 | 1 | ... | ... | 1 | |
| Ovary | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | ... | |
| Parotid | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Arm | 1 | 0 | 1 | | ... | 1 | 1 | ... | ... | ... | 1 |
| Epithelioma of | | | | | | | | | | | |
| Face | 3 | 0 | 3 | | ... | 3 | 2 | ... | 2 | | |
| Lip | 8 | 0 | 8 | | ... | 8 | 4 | ... | 2 | 1 | 1 |
| Penis | 1 | 0 | 1 | | ... | 1 | 0 | | | | |
| Tongue | 14 | 1(1) | 8 | Recurrence | 1 | 13 | 12 | ... | 1 | ... | 11 |
| | | | | Excision of nodes | 2 | | | | | | |
| Vulva | 1 | 0 | 0 | | ... | 0 | | | | | |
| Hypernephroma of | | | | | | | | | | | |
| Kidney | 1 | 1(1) | 0 | | | | | | | | |
| Sarcoma of | | | | | | | | | | | |
| Abdominal wall | 1 | 0 | 1 | | ... | 1 | 1 | ... | ... | ... | 1 |
| Bones | 7 | 0 | 7 | Recurrence | 1 | 6 | 6 | ... | 2 | 1 | 3 |
| | | | | | 1 died | | | | | | |
| Breast | 1 | 0 | 1 | Recurrence | Died | | | | | | |
| Leg | 1 | 0 | 1 | | ... | 1 | 0 | | | | |
| Intestines | 1 | 1 | 1 | | | | | | | | |
| Gum | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Kidney | 1 | 0 | 1 | Recurrence | Died | | | | | | |
| Lymph nodes | 4 | 0 | 4 | | ... | 4 | 1 | ... | ... | ... | 1 |
| Rectum | 1 | 0 | 1 | | ... | 1 | 0 | | | | |
| Spleen | 1 | 1 | 1 | | | | | | | | |
| Tendon sheath | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Testicle | 1 | 0 | 1 | | ... | 1 | 1 | ... | ... | ... | 1 |
| Teratoma, malignant | | | | | | | | | | | |
| Retroperitoneal nodes | 1 | 0 | 1 | | ... | 1 | 1 | ... | ... | ... | 1 |
| Adenocarcinoma of | | | | | | | | | | | |
| Omentum | 2 | 0 | 2 | Recurrence | Died | 1 | 0 | | | | |
| Adenopapilloma | 1 | 1 | 1 | | | | | | | | |
| Fibrosarcoma of | | | | | | | | | | | |
| Finger | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Ovary | 1 | 0 | 1 | | ... | 1 | 0 | | | | |
| Lymphosarcoma of | | | | | | | | | | | |
| Intestines | 1 | 0 | 1 | | .. | 1 | 0 | | | | |
| Jaw | 1 | 1(1) | 0 | | | | | | | | |
| Lymph nodes | 2 | 0 | 2 | | ... | 2 | 2 | ... | 1 | ... | 1 |

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|---|---|---|---|---|---|---|---|---|---|---|---|
| *Tumors, Malignant:* Continued | | | | | | | | | | | |
| Myosarcoma of Intestines | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Myxochondro-endothelioma Parotid | 2 | 0 | 2 | | ... | 2 | 1 | ... | 1 | | |
| Submaxillary gland | 4 | 0 | 4 | | ... | 4 | 1 | ... | 1 | | |
| *Urinary Organs:* | | | | | | | | | | | |
| Abscess urethra | 1 | 0 | 1 | Fistula in ano | 1 | 1 | 0 | | | | |
| Calculus in bladder | 6 | 0 | 4 | Calculus | Died | 3 | 2 | ... | 2 | | |
| Cystitis | 16 | 2 | 3 | Pulmonary tuberculosis | 0 | 5 | 4 | ... | 2 | ... | 2 |
| Calculus in ureter | 10 | 0 | 4 | | ... | 6 | 6 | 1 | 3 | 2 | |
| Calculus in urethra | 2 | 0 | 2 | Stricture of urethra | 1 | 2 | 2 | ... | 2 | | |
| Caruncle of urethra | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Cyst of kidney | 2 | 0 | 2 | | ... | 2 | 2 | 1 | 1 | | |
| Hæmaturia | 3 | 0 | 3 | | ... | 2 | 1 | 1 | | | |
| Hydronephrosis | 2 | 0 | 2 | | ... | 2 | 2 | ... | 1 | ... | 1 |
| Incontinence | 1 | 0 | 0 | | ... | 0 | | | | | |
| Leukoplakia of bladder | 1 | 0 | 0 | | ... | 1 | 0 | | | | |
| Nephralgia | 1 | 0 | 0 | | ... | 0 | | | | | |
| Nephritis | 10 | 5(4) | 6 | | ... | 4 | 3 | 1 | 1 | ... | 1 |
| Nephrolithiasis | 42 | 2 | 26 | Hæmaturia | 0 | 28 | 23 | 13 | 9 | 1 | |
| | | | | Nephrolithiasis | 1 | | | | | | |
| Nephroptosis | 10 | 0 | 7 | Pleurisy | 0 | 7 | 7 | 3 | 2 | 1 | 1 |
| Perinephritic abscess | 30 | 2(1) | 28 | | ... | 26 | 19 | 14 | 3 | 2 | |
| Pyelitis | 16 | 0 | 2 | | ... | 9 | 5 | 1 | 4 | | |
| Retention of urine | 2 | 1 | 1 | | ... | 0 | | | | | |
| Stricture of urethra | 31 | 1 | 29 | Fistula in ano | 2 | 21 | 10 | 3 | 4 | 2 | 1 |
| | | | | Acute appendicitis | 1 | | | | | | |
| Stricture of ureter | 4 | 0 | 4 | | ... | 2 | 2 | ... | 2 | | |
| Stricture neck of bladder | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Ureteral colic | 4 | 0 | 0 | Abscess prostate | 0 | 4 | 4 | ... | 3 | 1 | |
| *Obstetrical Conditions:* | | | | | | | | | | | |
| Abortion, incomplete | 102 | 0 | 99 | Acute cystitis | | 66 | 44 | 11 | 27 | 5 | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Salpingitis | 2 | | | | | | |
| | | | | Relaxed pelvic floor | 1 | | | | | | |
| | | | | Fibromyoma | 1 | | | | | | |
| | | | | Incomplete abortion | 2 | | | | | | |
| | | | | Retroversion | 1 | | | | | | |
| | | | | Endometritis | 1 | | | | | | |
| Abortion, threatened | 1 | 0 | 0 | | ... | 0 | | | | | |
| Parturition | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Pregnancy, normal | 24 | 0 | 1 | | ... | 0 | | | | | |
| *Injuries:* | | | | | | | | | | | |
| Fracture of | | | | | | | | | | | |
| Ankle | 19 | 0 | 2 | | ... | 16 | 13 | 3 | 8 | 2 | |
| Clavicle | 13 | 0 | 0 | | ... | 3 | 2 | 1 | ... | 1 | |
| Coccyx | 1 | 0 | 1 | | ... | 1 | 1 | 1 | | | |
| Elbow | 7 | 0 | 4 | | ... | 6 | 4 | 2 | 2 | | |
| Face, bones of | 8 | 0 | 4 | | ... | 5 | 5 | 2 | 3 | | |
| Femur | 50 | 2(1) | 18 | Prolapse uterus | 1 | 4 | 35 | 9 | 21 | 4 | 1 |
| | | | | Osteomyelitis | 2 | | | | | | |
| | | | | Sinus | 1 | | | | | | |
| | | | | Tonsils | 1 | | | | | | |
| | | | | Foreign body in thigh | 1 | | | | | | |
| | | | | Fracture of forearm | 0 | | | | | | |
| | | | | Fracture of femur | 0 | | | | | | |
| Foot | 12 | 0 | 4 | | ... | 9 | 5 | 2 | 1 | 2 | |
| Forearm | 48 | 0 | 18 | Faulty union | 2 | 39 | 33 | 5 | 26 | 2 | |
| | | | | Fracture of forearm | 0 | | | | | | |
| Hand, bones of | 13 | 0 | 13 | | ... | 11 | 7 | 1 | 6 | | |
| Humerus | 56 | 0 | 21 | Non-union | 1 | 43 | 32 | 9 | 22 | ... | 1 |
| Leg, bones of | 57 | 0 | 22 | Faulty union | 1 | 42 | 37 | 2 | 32 | 1 | 2 |
| | | | | Non-union | 1 | | | | | | |
| | | | | Dermatitis | 0 | | | | | | |
| | | | | Removal plate | 1 | | | | | | |
| Maxilla, inferior | 1 | 1(1) | 0 | | | | | | | | |
| Patella | 22 | 0 | 19 | | ... | 20 | 13 | 3 | 10 | | |
| Pelvis | 10 | 0 | 2 | | ... | 6 | 5 | 2 | 2 | 1 | |
| Ribs | 16 | 3(3) | 0 | | ... | 6 | 3 | 0 | 3 | | |
| Scapula | 9 | 1(1) | 0 | | ... | 7 | 4 | 2 | 1 | 1 | |
| Skull | 43 | 14(8) | 10 | | ... | 16 | 11 | 3 | 8 | | |
| Wrist | 38 | 0 | 6 | | ... | 36 | 25 | 5 | 17 | 3 | |

REPORT OF FOLLOW-UP WORK FROM FEBRUARY, 1913, TO DECEMBER, 1918, INCLUSIVE.—*Continued*

| Diagnosis | No. of cases | No. of deaths | No. of operations | Readmitted | 2nd operation | To return | Reported | Excellent | Satisfactory | Unsatisfactory | Died at home |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Injuries:* Continued | | | | | | | | | | | |
| Gunshot wound of | | | | | | | | | | | |
| Radius | 1 | 0 | 1 | | ... | 1 | 0 | | | | |
| Scapula | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Dislocation of | | | | | | | | | | | |
| Ankle | 2 | 0 | 1 | | ... | 2 | 2 | 2 | | | |
| Cartilage | 7 | 0 | 6 | | ... | 7 | 7 | 3 | 3 | 1 | |
| Elbow | 11 | 0 | 4 | | ... | 9 | 7 | 1 | 6 | | |
| Inferior maxilla | 1 | 0 | 0 | Arthritis | 1 | 1 | 1 | ... | 1 | | |
| Metatarsals | 1 | 0 | 0 | | ... | 1 | 1 | ... | 1 | | |
| Metacarpals | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Hip | 1 | 0 | 0 | | ... | 1 | 1 | ... | 1 | | |
| Radius | 1 | 0 | 0 | | ... | 1 | 1 | ... | 1 | | |
| Ribs | 1 | 0 | 1 | | ... | 0 | | | | | |
| Humerus | 20 | 0 | 6 | Fracture of humerus | 0 | 11 | 7 | 1 | 4 | 2 | |
| | | | | Dislocation | 0 | | | | | | |
| Wrist | 5 | 0 | 2 | | ... | 2 | 2 | 1 | 0 | 1 | |
| Foreign body in | | | | | | | | | | | |
| Joint | 8 | 0 | 8 | | ... | 5 | 5 | ... | 4 | 1 | |
| Bursa, prepatellar | 1 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Sprain of | | | | | | | | | | | |
| Sacro iliac joint | 2 | 0 | 0 | | ... | 1 | 1 | 1 | | | |
| Synovitis, traumatic | 3 | 0 | 1 | | ... | 1 | 1 | ... | 1 | | |
| Contusion of | | | | | | | | | | | |
| Joint | 3 | 0 | 0 | | ... | 0 | | | | | |
| Punctured wound | | | | | | | | | | | |
| Knee | 2 | 0 | 2 | | ... | 1 | 1 | ... | 1 | | |
| Injuries to | | | | | | | | | | | |
| Digestive system | 29 | 11(1) | 19 | Cystoma | 1 | 13 | 10 | 4 | 5 | ... | 1 |
| Ear | 2 | 0 | 2 | | ... | 2 | 2 | 2 | | | |
| Muscular system | 37 | 0 | 37 | Pelvic abscess | 1 | 33 | 31 | 2 | 25 | 4 | |
| Nervous system | 5 | 1 | 2 | | ... | 0 | | | | | |
| Reproductive organs | 5 | 0 | 2 | | ... | 4 | 3 | 3 | | | |
| Respiratory system | 4 | 1(1) | 2 | Bronchiectasis | Died | 2 | 2 | 2 | | | |
| Spleen | 2 | 0 | 2 | Ventral hernia | 1 | 2 | 1 | 1 | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Urinary organs | 4 | 1 | 2 | **Ventral hernia** | 1 | 2 | 1 | 1 | | | |
| Abdominal wall | 11 | 3(1) | 9 | ... | ... | 6 | 5 | 3 | 2 | | |
| Back | 12 | 1(1) | 7 | ... | ... | 5 | 3 | 3 | | | |
| Chest wall | 4 | 1(1) | 1 | ... | ... | 2 | 2 | ... | 1 | 1 | |
| Extremities, lower | 42 | 2 | 20 | Cicatricial contracture | 1 | 24 | 15 | 4 | 10 | 1 | |
| | | | | Ulcer | 0 | | | | | | |
| Extremities, upper | 61 | 2(1) | 49 | Skin grafting | 1 | 45 | 37 | 22 | 12 | 3 | |
| | | | | Cellulitis | 1 | | | | | | |
| Face and scalp | 25 | 1(1) | 10 | Retroversion | 0 | 10 | 8 | 3 | 4 | 1 | |
| Neck | 4 | 0 | 3 | ... | ... | 1 | 1 | 1 | | | |
| Perineum | 2 | 0 | 1 | ... | ... | 2 | 2 | ... | 1 | 1 | |
| Miscellaneous and multiple injuries | 20 | 7(5) | 8 | ... | ... | 7 | 6 | ... | 5 | 1 | |
| | 8028 | 358 | 6808 | | 367 | 5707 | 4324 | 1921 | 1827 | 393 | 183 |
| Readmission | 428 | 27 | 367 | (Of this number 27 died) | | | | | | | |
| Total | 8456 | 385 | 7175 | | | | | | | | |

* Under "Number of Deaths," figures in parentheses denote number included in other figures who died without operation. Of the 358 cases who died in the Hospital, therefore, 60 of these had no operation. Operative mortality, 4 per cent.

NOTE.—Total number of known deaths, both in and out of Hospital, 568. (Of this number 3 patients died of influenza after leaving the hospital.) Therefore of 8028 cases 7 per cent. are known to be dead.

NOTE.—Of 5707 cases asked to return for examination 75.5 per cent. returned. This percentage is lowered by the inclusion of the two unsatisfactory periods, *i.e.*, the year 1913 and the period of the war. Our percentage under normal conditions has been as follows: Mar. 11, 1916 (three months report), 93 per cent.; September, 1916 (six months report) 90.6 per cent.; Dec., 1916 (three months report), 88.7 per cent.; April, 1917 (three months), 90.6 per cent.

## APPENDIX

### Classification of Patients Returning for Second Operation*

| | No. of cases | No. of deaths |
|---|---|---|
| Malformations: | | |
| Harelip | 1 | 1 |
| Spinal column | 1 | |
| Bones and Cartilages: | | |
| Faulty union | 8 | |
| Osteomyelitis | 12 | |
| Bursitis | 1 | |
| The Circulatory System: | | |
| Aneurism | 1 | |
| Endarteritis | 3 | |
| Varicose veins | 3 | |
| The Digestive System: | | |
| Acute appendicitis | 5 | |
| Chronic appendicitis | 4 | |
| Fecal fistula | 3 | |
| Intestinal obstruction | 2 | 2 |
| Abscess of liver | 1 | |
| Cholelithiasis | 4 | 1 |
| Stenosis of gall-bladder | 1 | 1 |
| Pelvic abscess | 3 | |
| Adhesions of peritoneum (P. O.) | 13 | |
| Tonsils and adenoids | 12 | |
| Abscess about rectum | 4 | |
| Fistula in ano | 13 | |
| Fissure of anus | 1 | |
| Stricture of rectum | 1 | |
| Hemorrhoids | 6 | |
| Gastroptosis | 2 | |
| Gastric ulcer | 2 | |
| Gastric ulcer, perforating | 1 | 1 |
| Duodenal ulcer | 1 | 1 |
| Ductless Glands and Spleen: | | |
| Exophthalmic goitre | 1 | |
| Banti's disease | 1 | 1 |
| Splenomegaly | 1 | 1 |
| Herniæ: | | |
| Femoral hernia | 1 | |
| Inguinal hernia | 26 | |
| Inguinal hernia, strangulated | 3 | |
| Ventral hernia | 22 | 1 |
| Umbilical hernia | 1 | |
| Infective Diseases: | | |
| Abscess | 13 | |
| Cellulitis | 4 | |
| Syphilis | 1 | |
| Tuberculosis of intestines | 1 | 1 |

* The second operation is often for a condition different from the original disease, *e.g.*, hemorrhoids following chronic appendicitis. The patient's history card is filed under the original condition for which he entered the hospital. Subsequent admissions are entered on the same card, second diagnoses being cross referenced.

| | No. of cases | No. of deaths |
|---|---|---|
| Infective Diseases (Continued): | | |
| Tuberculosis of (continued): | | |
| joints | 8 | |
| bones | 4 | |
| peritoneum | 5 | 1 |
| costal cartilage | 1 | |
| skin | 1 | |
| epididymis | 2 | |
| fallopian tubes | 1 | |
| properitoneal tissue | 1 | |
| kidney | 1 | |
| lymph nodes | 23 | |
| Appendix | 1 | |
| Joints: | | |
| Ankylosis | 3 | |
| Arthritis | 3 | |
| Talipes | 1 | |
| Miscellaneous: | | |
| Abdominal sinus | 3 | |
| Foreign body in abdominal sinus | 1 | |
| P. O. wound | 1 | |
| Foreign body in abdominal wall | 1 | |
| P. O. hemorrhage | 1 | |
| Cicatricial contracture | 2 | |
| Ganglion | 1 | |
| Hæmatoma | 1 | |
| Revision of amputation stump | 1 | |
| Foreign body in thigh | 1 | |
| Skin grafting | 1 | |
| Parasites: | | |
| Actinomycosis of colon | 1 | 1 |
| Reproductive Organs (Female): | | |
| Metrorrhagia | 1 | |
| Mastitis | 4 | |
| Extrauterine gestation | 1 | |
| Chr. salpingitis | 16 | |
| Anteflexion of uterus | 1 | |
| Retroversion of uterus | 1 | |
| Prolapse of uterus | 2 | |
| Anteversion | 1 | |
| Relaxed pelvic floor | 3 | |
| Lacerated pelvic floor | 2 | |
| Endometritis | 7 | |
| Endotrachelitis | 1 | |
| Vulvo-vaginal abscess | 2 | |
| Reproductive Organs (Male): | | |
| Circumcision | 2 | |
| Hydrocele | 5 | |
| Respiratory System: | | |
| Suppurative pleurisy | 5 | |
| Abscess of lung | 2 | 1 |
| Bronchiectasis | 2 | 1 |
| Skin, Hair and Nails: | | |
| Ulcer of leg | 1 | |

| | No. of cases | No. of deaths |
|---|---|---|
| Tumors (Benign): | | |
| Adenoma of thyroid | 1 | |
| Cystoma of ovary | 8 | |
| Fibromyoma of uterus | 7 | |
| Teratoma | 1 | |
| Lipoma | 2 | |
| Osteoma | 1 | |
| Tumors (Malignant): | | |
| Carcinoma of gall-bladder | 1 | 1 |
| Carcinoma of stomach | 2 | 2 |
| Carcinoma of bladder | 1 | |
| Carcinoma of breast | 1 | 1 |
| Carcinoma of uterus | 4 | 1 |
| Epithelioma of uterus | 1 | |
| Epithelioma of tongue | 3 | |
| Carcinoma of intestines | 1 | |
| Sarcoma of bones | 2 | 1 |
| Sarcoma of breast | 1 | 1 |
| Sarcoma of kidney | 1 | 1 |
| Sarcoma of omentum | 1 | 1 |
| Urinary Organs: | | |
| Pyonephrosis | 1 | |
| Stricture of urethra | 4 | |
| Calculus in ureter | 1 | |
| Calculus in bladder | 1 | 1 |
| Nephrolithiasis | 1 | |
| Acute cystitis | 1 | |
| Obstetrical Conditions: | | |
| Incomplete abortion | 4 | |
| Injuries: | | |
| Lacerated wound of tendon | 1 | |
| Fracture of femur | 1 | 1 |
| Total | 367 | 27 |

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# THE RESULTS OF OPERATIONS FOR CHRONIC APPENDICITIS: A STUDY OF 555 CASES.[1]

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This study is based on two questions: (1) How often does the removal of a supposedly diseased appendix fail to relieve symptoms or improve the patient's condition and (2) what are the reasons of such failures and how can we avoid them?

Removal of the appendix is very common today. The great bulk of these operations is very easy and can be readily done even by those with little technical skill and a minimum knowledge of surgical principles and morbid anatomy. The immediate convalescence is easy and the psychic results are also a factor. The operation is particularly gratifying as a prophylactic measure when well-defined attacks have given anxiety lest the subject should be "caught" in the more serious or even tragic phases of an acute attack.

In a second class the removal of the appendix brings relief to symptoms which are indirect, particularly of the digestive apparatus. According to Moynihan's dictum, most of the ulcers of the stomach are situated in the right iliac fossa.

Both of the above classes furnish a legitimate and gratifying field, and if operations were limited to them there would be but few failures to record. Operations for chronic appendicitis have also given good results in that the operation, if conducted as an exploratory operation (as it should generally be), has resulted in removing an appendix, normal or altered, and in remedying at the same time some other important morbid process.

Unfortunately the second class is not sharply defined, and there is also a third and rather vague class—which might be called the symptomless class—in which the removal of the appendix has apparently greatly benefited the patient's general condition.

Owing to the vagueness of this third class, numerous patients are subjected to removal of the appendix needlessly and recklessly. Consequently a certain proportion of bad results must follow to the natural dissatisfaction of the patient, often to his great detriment, if a condition really needing surgical interference (*e. g.*, ureteral stone)

[1] Read before the New York Academy of Medicine, January 15, 1920.

was overlooked, and to the discredit of the profession. Witness the laws of a Western State which inflicts penalties for needless appendix operations.

An incorrigible humorist, the late Dr. Alexander Johnson, once answered a layman's inquiry as to the functions of the appendix by saying: "It contributes largely to the support of a noble profession." Many a truth is spoken in jest, but I dislike to think of our profession being either the principal or accessory to such a joke, and in this paper I hope to demonstrate what we have done in our hospital service toward lessening the opportunities for such jibes.

The thoughtful and conscientious element of the profession has for some time recognized that appendix operations not infrequently give bad results; but there has not been enough frank confession of these results or systematic attempts to obtain a remedy. It is natural and legitimate to err on the side of safety, and it is a fearful thing to tell a patient he has no reason to worry over his appendix and have the patient subsequently go through a severe acute operation or possibly die. Perhaps it will be better to resign ourselves to doing a certain number of these needless operations for the sake of safety. I believe we can reduce them by more painstaking methods of study of such conditions, particularly of the more common sources of error.

One great help is the study of results. Soon after the establishment of my follow-up system[2] in my service at the New York Hospital, in 1914, it became painfully evident that we were getting too many unfavorable reports in our chronic appendicitis cases, and measures were instituted along the lines to be described later for this improvement. The preparation of a formal study of a large number of conditions was delayed by war conditions, and it was not until this paper was undertaken that the full significance of many of the features necessary for improvement was realized.

TABLE I.

| Year. | No. of cases. | Per cent. unsatisfactory. | Per cent. of McBurney incisions. |
|---|---|---|---|
| 1913 | 70 | 28 | 74 |
| 1914[3] | 63 | 23 | 65 |
| 1915 | 98 | 28 | 21 |
| 1916 | 100 | 26 | 36 |
| 1917 | 119 | 24 | 35 |
| 1918 | 84 | 20 | 14 |
| 1919 (6 months) | 21 | 11 | 10 |

Table I shows that of late our results have been much better. Also the greater degree of exploration we are now making by

[2] Annals of Surgery, September, 1916, No. 3, vol. lxiv; December, 1919, No. 6, vol. lxx.

[3] After my follow-up system had been in effect a year the McBurney incisions dropped notably.

abandoning the small or interval incisions. We are also doing either fewer operations for chronic appendicitis or operating on cases under a different and correct diagnosis.

This paper is based on a study of 555 patients in the ward (no private) service of the First Surgical Division of the New York Hospital, January 1, 1913, to July 1, 1919. Of this number we have no record of 126 patients.[4] We have good reasons, to be stated later, for believing that our best results were obtained in the patients who failed to report, consequently the basing of end-results on only the 426, restricting the reported number, makes the results seem worse than they really are.

We have preferred to take the facts as they appear in our records rather than yield to the temptation of juggling of figures in any way. Several of our cases are obviously not cases of chronic appendicitis, the main operation being something else, but the discharge cards read (as a result of carelessness) "Chronic appendicitis," and are so recorded. (The service was kept going with great difficulty during the war.) The work has been done by myself, the two associate surgeons, Drs. J. M. Hitzrot and B. J. Lee; Dr. C. E. Farr, assistant surgeon, and, for a short period, by Dr. L. A. Wing.

For the sake of clearness the cases have been divided into five categories:

*Class A* (259). *Excellent.* Patients who on reëxamination present no complaints whatsoever.

*Class B* (65). *Satisfactory.* No complaints pointing to their former condition, but have some minor complaint.

*Class C* (102). *Unsatisfactory.* Patients who have not been improved.

*Class D* (126). *Unknown.*

*Class E* (3). *Deaths.*

All classes have been studied under the same headings. Table II gives a summary of the principal findings common to all classes.

We note that the age distribution seems to be about the same in all classes, the largest percentage of operations being performed on patients between the ages of twenty and thirty. It will be noted also that the unsatisfactory cases were the ones averaging the longest stay in the hospital. This fact probably means that their cases were obscure and reluctance was felt to operate on them without sufficient observation.

Under "Special Examinations" we mean more particularly gastric analyses and bismuth series of the gastro-intestinal tract. There is not much difference in any of these classes, the lowest being the unknown, occurring largely in our first year before we had systematized our hospital service.

[4] Many of these are 1913 patients who could not be traced after a period longer than the usual three months.

By "Further Exploration" is meant that a record exists in the history of the operation that investigations of the abdomen were made besides the removal of the appendix. Considerably less of this exploration apparently was made in the classes "Satisfactory" and "Unknown," probably owing to the very obvious pathological condition of the appendix as noted in the percentage of those conditions found.

TABLE II.

| | Excellent, per cent. | Satisfactory, per cent. | Unsatisfactory, per cent. | Unknown, per cent. |
|---|---|---|---|---|
| Male[5] | 70 | 14 | 16 | |
| Female | 56 | 16 | 28 | |
| Nationality (English speaking) | 43 | 49 | 29 | 38 |
| Age: | | | | |
| 1 to 10 years | 1 | 2 | 2 | 2 |
| 10 to 20 " | 29 | 23 | 27 | 22 |
| 20 to 30 " | 46 | 56 | 48 | 52 |
| 30 to 40 " | 17 | 12 | 15 | 20 |
| 40 to 50 " | 5 | 3 | 4 | 2 |
| 50 to 60 " | 2 | 2 | 1 | 2 |
| 60 to 70 " | .. | 2 | 3 | |
| History of well-defined attacks | 51 | 51 | 35 | 47 |
| Analysis of chief symptoms: | | | | |
| Pain, R. L. Q. | 50 | 35 | 30 | 50 |
| Pain and vomiting | 15 | 15 | 13 | 16 |
| Pain in epigastrium | 7 | 5 | 9 | 6 |
| Pain and constipation | 9 | 25 | 8 | 5 |
| Average number of days spent in hospital before operation | 2.57 | 2.53 | 3.19 | 2.30 |
| Special examinations[6] | 46 | 54 | 56 | 36 |
| Kind of incision: | | | | |
| McBurney | 37 | 22 | 31 | 52 |
| Large | 63 | 78 | 69 | 48 |
| Appendix pathological | 85 | 75 | 63 | 77 |
| Further exploration | 52 | 83 | 73 | 52 |
| Complications | 22 | 38 | 22 | 18 |
| Subsequent admission | 2 | 0 | 25 | 2 |
| Subsequent operation | 1.5 | .. | 5 | 2 |

[5] The percentage of satisfactory cases was 72 per cent. for women, 88 per cent. for men.

[6] Diagnosis more obvious in lesser number of tests. Notes have all been more precise in the more recent years since we have learned the necessity of precision of data.

By "Complications" we mean the existence or remedying of other conditions whether intra-abdominal or not.

POINTS OF SPECIAL INTEREST IN EACH CLASS.

*Class A.* Excellent, 259.

The larger proportion of males. Men have fewer conditions to obscure the diagnosis. There are more men carrying a really diseased appendix. Of our 820 operations for *acute* appendicitis 64 per cent. were men.

Larger proportion, as in Class B, of English-speaking people (who are in a minority in the New York Hospital). As the greatest single factor in diagnosis is a clear and reliable history we are much handicapped by the limitations of speech and intelligence of our patients. The larger proportion of histories giving definite pain, 50 per cent., in the right lower quadrant.

Definite record of the removal of an obviously pathological appendix, 85 per cent., compared to the 63 per cent. in the unsatisfactory Class C. These findings are dictated in the operating room in the hearing of the assistants and onlookers.

Only 2 per cent. of these patients were readmitted (for other conditions), while 25 per cent. of unsatisfactory, Class C, came back.

*Class B. Satisfactory*, 65.

Class B shows substantially the same features, but is less marked as regards the three main features, per centage of males, pathological appendix and pain in R. L. Q. It is in this class of cases that we may have occasionally overlooked some cause for their minor complaints.

ANALYSIS OF POSTOPERATIVE COMPLAINTS.

| Complaint. | No. of cases. |
|---|---|
| Constipation | 29 |
| Gynecological conditions | 6 |
| Pain elsewhere | 3 |
| Backache | 4 |
| Bladder trouble | 2 |
| Pain in scar | 4 |
| Indigestion | 6 |
| Vague complaints | 11 |

Of the group classed as satisfactory, but exhibiting minor complaints, we note the largest (with the exception of constipation), 11 cases, as absolutely vague, such as "having a burning sensation when she wears corsets." Six are gynecological troubles, such as leucorrhea and lacerated cervix. A little pain in scar or slight indigestion make up the next largest groups.

*Class C.* Unsatisfactory, 102.

This is the class which is really the subject of the paper and deserves the fullest analysis. All reasonable efforts were made to have the patients subject themselves to more examinations, particularly those bearing on symptoms complained of, *e. g.*, gastric

analyses and roentgen ray for gastro-intestinal conditions, also roentgen ray of the urinary tract. Twenty-five per cent. were persuaded to reënter the hospital for observation. The results are shown in Table III.

TABLE III.—SUBSEQUENT ADMISSIONS AND OPERATIONS, 26.

Gastroptosis, 3 cases. All cases had gastric analysis and bismuth series.

Neurasthenia and rheumatism, 1 case.

Postoperative constipation, 1 case. Gastric analysis.

Readmitted for bismuth series, negative result, 4 cases.

Adhesions of peritoneum, no operation, 5 cases.

Five cases had bismuth series. Negative, with exception of one case, which showed possibly slight gastroptosis.

Adhesions of peritoneum, operation, 3 cases.

1. Operation showed adhesion of omentum to scar. Adhesion divided. Six months after second operation patient still complained of indefinite pain on the right and the left side of the abdomen.

2. Operation showed adhesions of the peritoneum and abscess of the colon. Nine months after this operation the patient was again admitted, with diagnosis of adhesions. Operation thought inadvisable.

3. Two operations for adhesions. First fourteen months after appendectomy, second a year and seven months later. Readmitted a third time, with same diagnosis, but operation was thought inadvisable.

Removal of cystoma of right ovary, 1 case. "Neurasthenic wreck."

Cholecystectomy for cholelithiasis, 1 case. Six months after this second operation the patient came back, complaining of symptoms which point to adhesions.

Roentgen ray of sacro-iliac joint suspicious of arthritis, 1 case.

Roentgen ray of kidney negative, 3 cases.

Possible ulcer of stomach, 2 cases.

Bismuth series and gastric analysis.

Readmitted for investigation, diagnosis unknown, 1 case. Gastric analysis.

This series of readmission cases (the severer) showed therefore:

Four cases of gastroptosis (3 cases had pathological appendix).

Four presumptive postoperative adhesions.

One cholelithiasis.

One cystoma of ovary.

Three definite trouble from adhesions as proved by operation

We may say, therefore, that mistakes were made in not looking for or missing the cholelithiasis and the ovarian cyst, and that it was probably a mistake to have operated at all on the cases of gastroptosis.

It is impossible to judge whether adhesions are due to original conditions or to the appendectomy. Turning in of the stump of the appendix, as is our custom, leaves a minimum of irritation, but I have seen severe adhesions following.

In patient's not reëntering the hospital further study and examinations were unsatisfactory. Many flatly refused any form of examination, particularly those subjecting them to discomfort and loss of time. Expense was also a drawback, as these patients are required to pay for their roentgenray examination. As a consequence we are quite often unable to get an intelligent impression of the results, particularly in distinguishing ordinary kicks and neurotic manifestations.

Table IV shows the grouping of complaints, with data as to sex and condition of appendix:

TABLE IV.

| Unsatisfactory (chief complaint after operation). | Male. | Condition of appendix. | | Female. | Condition of appendix. | |
|---|---|---|---|---|---|---|
| | | Path. | Not path. | | Path. | Not path. |
| Pain in region of gall-bladder | 1 | ... | 1 | 2 | 2 | |
| Pain over right kidney | ... | ... | ... | 2 | 1 | 1 |
| Diarrhea | 1 | ... | 1 | | | |
| Pain in epigastrium | 4 | 3 | 1 | 3 | 2 | 1 |
| Great many vague pains and symptoms | 5 | 4 | 1 | 16 | 8 | 8 |
| Diastasis of recti | ... | ... | ... | 1 | ... | 1 |
| Severe pain just below umbilicus. | 1 | 1 | | | | |
| Wound still discharging | 1 | ... | 1 | | | |
| Severe pain in right side, especially during menstrual period | ... | ... | ... | 3 | 3 | |
| Pain in appendix region | 1 | 1 | ... | 19 | 14 | 5 |
| Pain in right lumbar region and discomfort about scar | ... | ... | ... | 1 | 1 | |
| Abdominal pain and cramps | 1 | ... | 1 | 6 | 3 | 3 |
| Pain both sides of abdomen | ... | ... | ... | 1 | 1 | |
| Pain in region of splenic flexure | ... | ... | ... | 1 | ... | 1 |
| Feels sick, loss of weight, appetite poor and bowels bad | ... | ... | ... | 1 | ... | 1 |
| Pain on left side, headache, poor appetite | ... | ... | ... | 1 | 1 | |
| Nausea and loss of weight | ... | ... | ... | 1 | ... | 1 |
| Constipation, poor appetite, pain in scar | ... | ... | ... | 1 | 1 | |
| Indigestion, obstinate constipation, pain in back | ... | ... | ... | 1 | 1 | |
| Constipation, headache, vomiting | ... | ... | ... | 1 | ... | 1 |
| Great deal of tenderness in scar | ... | ... | ... | 1 | 1 | |
| Cramps at night, loss of sleep, loss of weight | ..... | ... | ... | 1 | 1 | |
| Gas and soreness, R. L. Q. | 1 | 1 | | | | |
| Great deal of pain in right groin | ... | ... | ... | 1 | 1 | |
| Same pain as before operation | 8 | 5 | 4 | 12 | 9 | 3 |
| Pain and discomfort in lower right abdomen | ... | ... | ... | 2 | 1 | 1 |

Analysis of chief complaint after operation shows pain in some form as the main factor. It comes mainly under four headings:

1. Great many vague pains and symptoms, seen mostly in women (16), 21 cases.
2. Pain in appendix region (19 women, 1 man), 20 cases.
3. Same pain as before operation (8 men, 12 women), 20 cases.
   (*a*) Pain in epigastrium, 1 case.
   (*b*) Abdominal pain, 2 cases.
   (*c*) Pain in right inguinal region, 1 case.
   (*d*) Discomfort in lower abdomen, 1 case.
   (*e*) Pain in right iliac region, 1 case.
   (*f*) Indigestion and gas, 1 case.
   (*g*) Pain in R. L. Q., 13 cases.
4. Pain in epigastrium (4 men, 3 women) 7 cases.

Of the 65 cases in which the appendix was obviously pathological, 66 per cent. had further exploration at the time of the operation.

Of the 37 cases in which the appendix was not obviously pathological, 84 per cent. had further exploration at the time of the operation.

In group 1 and 2 it is legitimate to believe that most of these were unjustified complaints, for the sake of making a "kick" or "nerves."

In groups 3 and 4 it is more likely that the real cause was overlooked. These two classes showed a clean-cut preponderance of definitely pathological appendices, hence the operator probably did not make so thorough a search for a coexistent lesion as he would have felt it necessary to make if he had found originally an innocent-looking appendix.

In this class exploration of the abdomen showed a number of conditions which were remedied, some non-remediable by operation, and in a smaller group it is not obvious if any attempt was made to remedy the trouble. In 40 cases exploration was negative. Most of the troubles were gynecological or due to adhesions. On the whole one gets the impression that the explorations were thorough and the conditions found generally satisfactorily remedied, so that the poor results in this group were not due to careless or insufficient operation.

How shall we explain the results in this group in which in the majority (63 per cent.) the appendix is stated to be definitely pathological? I think it is fair to say that in a certain number there were in addition to a true appendix other conditions which we overlooked, lulled into a false security by the fact that there was a definitely pathological appendix and therefore did not make the operation a true exploratory laparotomy with a large incision allowing of a more nearly complete examination, particularly of the upper abdomen. The frequent coexistence of disease of the upper abdomen with a chronic appendicitis is today well established. Every surgeon of large experience can relate coexistence of a certain number of cases

of acute appendicitis, with other conditions which give rise to the "acute abdomen." Offhand I can remember two acute appendices coexistent with ruptured ectopic, also coincident with a torsion of an ovarian cyst, also a recent acute appendix, with a subacute perforation of the duodenum. The lesson, therefore, is to do more thorough work, even if a definitely chronic appendix is found, look for other possible lesions, particularly in women and those past the second decade, and more particularly the third. At an earlier period gastro-intestinal conditions, biliary lesions, diseases of the pelvic viscera, especially the sequelæ of pregnancy, are rare.

We do not have to be too apologetic for the results of Class C (unsatisfactory cases); that 63 per cent. of them were safely and on the whole comfortably rid of a definitely bad appendix is by no means a surgical failure.

*Class D.* Unknown, 126.

This class would probably represent the most satisfactory cases, as it corresponds largely to the conditions noted in "Class A," or Excellent, the large proportion of males, history of well-defined attacks, pain in the right lower quadrant and obviously pathological appendix. A large proportion of these patients were operated on in 1913, but were not sent for until a much later date, and therefore could not be traced.

*Class E.* Deaths, 3. The three deaths were due to:

1. Postoperative intestinal obstruction.
2. Acute general peritonitis and lobar pneumonia.
3. Cellulitis of abdominal wall, multiple intra-abdominal abscesses and pulmonary tuberculosis. The sepsis was the result of using unsterilized material at operation, due to the mistake of a green orderly.

A fourth death might be included technically in this series under chronic appendicitis. It is, however, such a faulty diagnosis that I feel justified in eliminating it. The patient entered the hospital and was operated on under the diagnosis of chronic appendicitis. Operation, March 7, 1916, the appendix could not be found. Reentered the hospital June 8, 1916, for an operation for repair of a fecal fistula, the lesion at that time being diagnosed as tuberculosis of the intestines. November 2, 1917, he underwent another operation for the cure of the fecal fistula and ventral hernia, from which he died.

To avoid disappointing results after operations for chronic appendicitis I recommend:

1. A comprehensive and detailed history.
2. A complete and thorough physical examination, including all refinements of diagnosis.
3. Exercise caution in undertaking operation on women as compared to men.

4. Exercise caution, particularly in the more mature patients, particularly women. In this class other lesions may coexist or may be mistaken for appendicitis.

5. Avoid the neurasthenics of any age or sex.

6. Exercise particular restraint when there is no clear and reliable history of well-defined attacks, particularly of localized pain accompanied by nausea or vomiting.

7. Make a good-sized incision, and, even if a frankly pathological appendix is found, look for other possible lesions.

8. If no obviously pathological appendix is found, do not cease looking for other lesions until every other possibility has been exhausted; make a supplementary incision if necessary.

NOTE. In discussing this paper, Dr. C. H. Peck alluded to the possibilities of trouble due to adhesions possibly provoked by the irritating effects of tincture of iodin carried from the surgeon's gloves from the skin.

It suddenly occurred to me that the explanation of the very marked improvement in results for the six months ending July 1, 1919 (11 per cent. of unsatisfactory results as compared to 20 per cent. in the year 1918), might very well be due to the absence of this irritating property of iodin, as in December, 1918, we instituted in our service the use of 5 per cent. alcoholic solution of picric acid for the skin. We are very sure of the superiority of this method as regards irritation of the skin. Of nearly 1500 cases we have had only one that showed any irritation at all, and that extremely trivial. Experiments are now being conducted by Dr. Charles E. Farr, assistant surgeon, concerning the comparative irritation of picric acid on the peritoneum.

Should the presumption raised by this improvement in our figures be confirmed by further experiments, especially by others, a very notable improvement in operative technic would ensue. As noted before, the chief and very constant complaint of patients returning for observation who were not satisfied by their operation is pain, and it might well be pain due to the irritation of the iodin, as it is particularly noticeable that the pain so frequently mentioned is at the operative site, although an unquestionably pathological appendix has been removed.

It is also interesting to contrast the practical absence of complaints of our patients who have been operated on for acute appendicitis. When reëxamined they are quite free from complaints. Of course, with an acute operation little or no exploration is usually made and only a very small field is exposed.

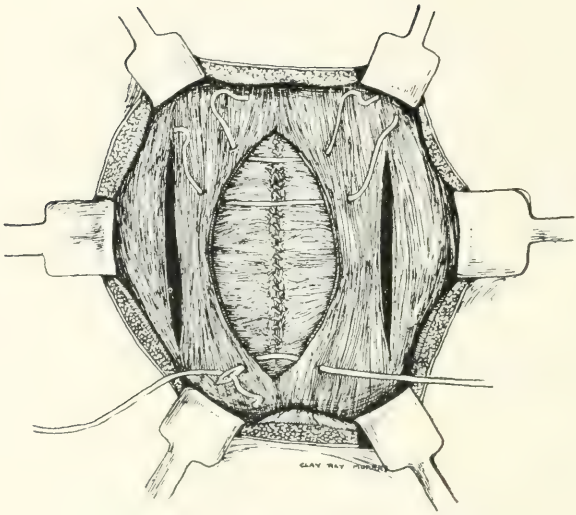

FIG. 1.—Releasing incisions in the fascia of the rectus muscle parallel to the line of suture.

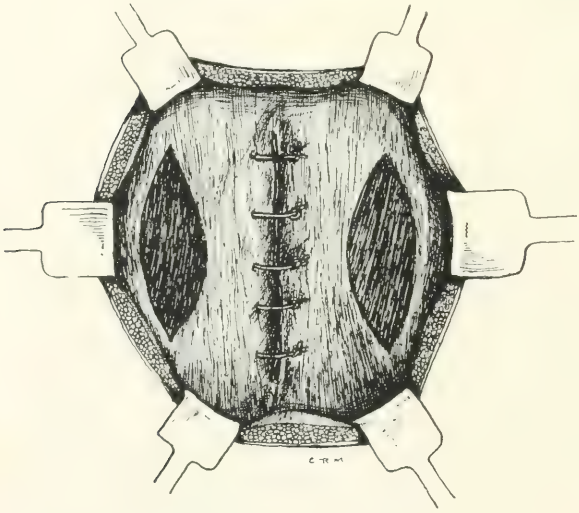

FIG. 2.—Edges of fascia reunited in midline without tension.

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# OPERATION FOR CURE OF LARGE VENTRAL HERNIA*

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A BRIEF description of this operation was made in my article on "Post-operative Intestinal Obstruction," ANNALS OF SURGERY, April, 1916. My experience in this particular procedure now numbers eight cases and the results have been very gratifying. This operation is not intended to supplant the customary operations for repair of incisional hernia or cure of umbilical hernia. It is intended for those cases for which the ordinary operations are not applicable and, in fact, usually quite impossible. The bulk of these cases would have been denied operative relief or subjected to some procedure of doubtful value, such as the implantation of a filigree.

The first operation in 1914 was done on the spur of the moment in an effort to give the patient a competent abdominal wall which was necessary to her profession as physical training instructor. It was felt at that time that the particular procedure used was somewhat hazardous, and it was a source of surprise and gratification that the operation succeeded perfectly, and at the end of six years there are no signs of any recurrence and the functional result is perfect.

Encouraged by this original result, similar operations were performed in cases of increasing magnitude, some of them apparently too great to be overcome. Success, however, attended all cases except the last (Case VIII), which showed that the limit of operative possibilities had been attained. This was a recurrent case (see photograph) with enormous prolapse and a conservative estimate was made at the time of the operation that the abdominal gap would easily correspond to the size of an adult head.

*Operation.*—The main principle of the operation is to close the gap chiefly by approximating the refreshed edges of the sheath of the rectus, tension being relieved by releasing incisions parallel to the line of suture on either side. This procedure is exactly similar to the operation for closure of cleft palate, according to Langenbeck, by double pedunculated flaps.

The operation is long and tedious. Before the abdominal incision can be closed the herniated contents of the sac must be properly separated and reduced. The closure is made in layers: first, peritoneum, which usually does not present any great difficulty. The next layer is usually quite deficient, as the muscles have disappeared, either from the original suppuration and sloughing or from atrophy. However, as much tissue as can be sutured under the fascial layer is secured. The releasing incisions

* Read before the American Surgical Association, May 4, 1920.

can be made before or after the suturing of the refreshed fascial edges. In extreme cases it must be made before. The width and length of the fascial flap can be determined by the conditions of tension. One must have the courage of one's conviction and extend the releasing incisions sufficiently to take off all undue tension. Ordinarily the flap of fascia would be about two inches wide. The greatest difficulty in making these flaps is in cases of hernia through the upper mid-abdomen, where the releasing incisions have to be carried on to the costal arch. Chromic catgut, mostly interrupted sutures have been used for the fascial closure. These sutures may be sometimes reënforced to advantage by passing some silkworm gut sutures through all the layers superior to the peritoneum.

Experience has shown that most of these wounds do not heal by primary union and a certain amount of discharge, usually non-purulent, is to be expected. It is possible that this accident is caused by spots of necrosis due to too great tension on the fascial sutures. Therefore, the superficial wound should be appropriately drained. Notwithstanding this complication in wound healing, none of these cases seem to have been injured as far as regards curative results.

My experience comprises eight cases. The ninth case, done according to the technic described here by one of my colleagues in my service, did not survive, succumbing to operative shock and paralytic ileus. Of the remaining eight cases only Case VIII, the severest, has shown any signs of recurrence. Case V is particularly interesting, as the patient had been subjected to numerous operations for an abdominal hernia which developed sixteen years prior to my intervention and had worn a filigree for five years which had successfully overcome the hernial protrusion for four years.

The surprising feature in the after results of these cases is the lack of weakness of the abdominal wall where the fascia gapes as the result of being pulled away. I had feared originally that there would be more trouble of possible protrusion at this point than of recurrence of the hernia, but with the exception of the case noted no trouble has developed.

Case I.—I. F., aged thirty-four years, female.

*First Operation.*—February, 1912. Operation for appendicitis.

*Second Operation.*—April 14, 1913. Resection of 20 inches of ileum and anastomosis with Murphy button for intestinal obstruction. At discharge, June 14, 1913, wound was closed save for small spot at lower angle.

*Third Operation.*—February 24, 1914. Hernia appeared three months previously (November, 1913). Operation for ventral hernia complicated by chronic adhesive peritonitis. Several feet of intestines unravelled. Wound healed by primary union save where hæmatoma had formed, broken down, and discharged. Discharged March 20, 1914.

*Follow-up Notes.*—June 10, 1914: Abdominal wound firm. No

FIG. 3.—Case II*A*. Taken September 28, 1915.

FIG. 4.—Case II*B*. Taken January 5, 1917.

FIG. 5.—Case III. Photograph taken April 1, 1916.

FIG. 6.—Case V. Taken March 30, 1920, showing filigree removed at fourth operation.

FIG. 7.—Case V. Taken March 30, 1920.

FIG. 8.—Case VIII. Taken November 23, 1919.

FIG. 9.—Case VIII *B*. Taken April 15, 1920.

suspicion of bulging in the wound or elsewhere in the abdomen. February 1, 1920: Excellent condition.

Case II.—N. W., aged thirty-nine years, male.

*First Operation.*—Cholecystostomy for cholelithiasis. February 13, 1915. Complicating operation, patient had an acute bronchitis and in coughing stitches yielded. Large hernia formed in scar.

*Second Operation.*—October 9, 1915: On ninth post-operative day wound was found infected. On tenth post-operative day free discharge of bile, probably all coming out of sinus in midline. Union of fascia and muscle for the most part seems firm, bulk of wound having escaped infection. On twenty-third post-operative day still profuse biliary discharge. Hernia operation seems to have held; condition excellent. On thirtieth post-operative day discharge markedly decreased. Abdominal repair seems to be firm. On thirty-ninth post-operative day patient discharged (November 17, 1915). Wound healed by primary union save at upper angle where wound opened to allow escape of biliary discharge, now slight in amount.

*Follow-up Notes.*—January 3, 1916: Discharge has returned. No impairment of abdominal wall. May 16, 1917: Wound firmly healed. Excellent condition. May 31, 1919: Excellent condition. No recurrence.

Case III.—L. P., aged nineteen years, male.

*First Operation.*—June 12, 1913: Appendectomy and drainage for acute appendicitis. Hernia developed two weeks after discharge. Has gradually increased in size until protrusion is now the size of two fists.

*Second Operation.*—April 3, 1916: Convalescence delayed by superficial hæmatoma. Discharged thirty-eighth post-operative day. Skin edges still separated. No impulse on coughing.

*Follow-up Notes.*—October 26, 1916: Wound firmly healed. No impulse. January 10, 1917: Excellent condition. Gaining flesh. Scar firm. February 27, 1919: Excellent condition.

Case IV.—J. F., aged sixty years, male. Hernia not post-operative. Has had ventral hernia for over four years. Came out gradually. Is now about size of fist. Strong impulse on coughing.

*Operation.*—July 26, 1918: Discharged August 13, 1918. Wound healed primarily.

*Follow-up Notes.*—March 6, 1920: No recurrence.

Case V.—C. S., aged fifty-one years, female.

*First Operation.*—October 16, 1902: For epigastric hernia.

*Second Operation.*—August 15, 1912: Repair of ventral hernia.

*Third Operation.*—September 8, 1913: Repair of ventral hernia with insertion of wire filigree (local anæsthesia).

*Fourth Operation.*—Readmitted October 29, 1918. One year ago patient noticed bulging to left of old ventral hernia repair scar. Wire broke through skin about ½ inch about six weeks before this admission. Some of the wire was removed. Has pain at site, especially on coughing. Filigree removed under local anæsthesia October 31, 1918. November 23, 1918: Operation for repair of ventral hernia. Thirty-eighth post-operative day wound explored under ether. Skin

tunnelled along line of incision. Involved area widely converted into one large wound which was packed open with balsam gauze. Fifty-first post-operative day allowed up. Fifty-seventh post-operative day still has a small granulating area. Hernia apparently cured. No impulse or bulging on coughing. Abdominal wall firm at site of former hernia. Patient discharged.

*Follow-up Notes.*—May 1, 1919: Firmly healed. Excellent condition. March 30, 1920: Excellent condition. No recurrence.

CASE VI.—M. M., aged fifty years, female.

*First Operation.*—December, 1901: Left salpingectomy for ectopic gestation.

*Second Operation.*—December, 1902: Laparotomy through old scar. Right salpingo-oöphorectomy for salpingo-oöphoritis. Convalescence complicated by fecal fistula.

*Third Operation.*—Readmitted July 7, 1919. Hernia appeared eight or nine years after last operation (1910 or 1911). Two lumps, size of orange, one at each end of incision. Has worn belt ever since she first noticed them. Operation July 8, 1919. Discharged August 10, 1919. Wound healed by primary union.

*Follow-up Notes.*—June 1, 1920: Excellent result. No bulging.

CASE VII.—B. W., aged fifty-eight years, male.

*First Operation.*—One year before second operation. Extensive operation for cholelithiasis. Wound broke down and hernia developed two months later.

*Second Operation.*—Examination: Very large individual. Ventral hernia size of child's head at term through scar in midline, reaching from umbilicus to ensiform. Operation May 23, 1919. Operation attended with much difficulty, lasting two hours and a half.

*Follow-up Notes.*—August 1, 1919: Patient writes that he is exceedingly well. Later but indirect reports indicate continuance of good result.

CASE VIII.—M. Z., aged forty-eight years, male.

*First Operation* (1914).—Operation for gall-stones.

*Second Operation* (1916).—Operation for ventral hernia which appeared six months after last operation.

*Third Operation* (1918).—Operation for recurrent ventral hernia. Hernia appeared three months after last operation.

*Fourth Operation* (November 26, 1919).—On twenty-sixth post-operative day considerable discharge. There is a sinus which extends upward and to the left. Counter incision made. Drainage. Fortieth post-operative day discharge stopped. Small sinus at either angle. Forty-sixth post-operative day: Discharged.

*Follow-up Notes.*—February 26, 1920: General bulge, but apparently not recurrence. March 22, 1920: Little recurrence in midline and some bulging without protrusion at site of releasing incision on left side.

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# THE TREATMENT OF EMPYEMA*

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THE purpose of this brief communication is not to present any original ideas concerning the treatment of empyema, but rather to call attention to the pathology of the disease, and consider in how far the various methods in vogue are sound in conception and technic.

The name "Empyema" is, in itself, lacking in clearness. In current usage it is sufficiently ill-defined to be a source of confusion in discussing treatment. It is not unusual to find such a discussion involving several quite different pathological processes, and any attempt to unify treatment is obviously futile.

Empyema should be used to indicate a purulent exudate within the general pleural space, limited only by the extent of the infective process. Local collections of pus, walled off by adhesions, are intrapleural abscesses or interlobar abscesses, and have no place in this discussion. A communication with the bronchial tubes is a complication of the condition under discussion. An abscess within the lung tissue is another complication. The presence of these complications may not materially alter the treatment needed for the empyema, but it is more than apt to do so, and success or failure of the treatment may in no way depend upon the pathology of the empyema itself.

Again, in considering empyema proper, one is required to differentiate between many important factors. The infecting organism is a matter of the greatest import. One would hardly include in the same category a peritonitis due to a perforated gastric ulcer, an acute gangrenous appendicitis and the migration of the gonococcus through the Fallopian tubes. There are quite as distinct differences between an empyema of streptococcus hæmolyticus and pneumococcus origin as between the peritonities named. Again, the path by which the infection gains entrance into the pleural space plays an important part. It may be by a direct extension of the pulmonic infection breaking in miliary fashion through the visceral pleura; it may be by way of the lymphatics, either in the form of actively growing thrombi in the vessels, or possibly by the organisms following the lymph current, though normally this is probably away from the pleural surface; or it may be simply an expression of a general blood invasion, with the empyema only one manifestation of its extensive outbreak.

* Read before the American Association for Thoracic Surgery, June 9, 1919.

Until discussions on treatment narrow themselves to one or another of these numerous pathological entities, confusion is bound to be supreme, and routine surgery only chance bungling.

During the past two years empyema has forced attention from a large number of physicians and surgeons who, heretofore, only took a passing interest in it. Its prevalence has been rather in excess of any surgical condition we have been called upon to treat. It has been, to a large extent, secondary to pneumonic processes associated with the influenza pandemic. A majority of these lung infections have been caused by, or associated with, the streptococcus hæmolyticus, which, in ordinary times, is not a prevalent factor. Very much of the discussion concerning empyema has originated with those who have had no extended experience with the disease in former times, and their views have been formulated on but one phase of the subject, without a full comprehension of the diversity of its pathology.

As demonstrated by McCallum,[1] this streptococcus almost invariably invades the pleural surface. Early in the disease, when terminating fatally, there is not only an infected exudate in the pleural cavity, but the visceral surface is covered with velvety granulation tissue. The pleura itself is thickened with œdema and other inflammatory products, and in many instances adhesions between the two surfaces are found. In some instances, as determined by the clinical course, this invasion of the pleura subsides with the pneumonic process, but in others it persists as an empyema after the lung condition is healed. The pathological process when the various types of pneumococcus unassociated with the influenza disease are the infective organisms is quite different from the above. The pleura is much less frequently involved, and when it is, the pleuritis is more nearly a sequella; that is, it begins when the pneumonia is subsiding. The thickening of the pleura at autopsy is found to be much less than in streptococcal infection. This finding, however, is not indicative of the condition when a well-established pneumococcus empyema is present. In fatal pneumococcus pneumonia, death occurs before this stage is reached, and therefore autopsies on such cases show only the pleural lesion of the pneumonia, and not the empyema. If such cases survive the pneumonia, and later die from an empyema, either with or without operation, the pleural membranes show a much more marked thickening. This is also usually present when operation is undertaken comparatively early.

In essence, therefore, empyema in its simplest uncomplicated form is a purulent inflammatory process going on in a closed serous cavity. Under these conditions pus is formed under pressure, and since the thorax is comparatively rigid, there results a compression of its contents. The most easily compressible structure is the lung itself, and this organ loses a part of its air content. At the same time, its delicate serous covering becomes a more or less rigid barrier and offers resistance to the compressing proc-

[1] Rockefeller Institute for Medical Research No. 10, April 16, 1919.

ess. This results in forcing over to the other side the mediastrium and the heart, and in many instances depresses the diaphragm. This is the extent of the process in the majority of the cases that occur as sequella to lobar pneumonia under its ordinary occurrence in non-epidemic form. This is the disease for which through many years there has gradually developed an almost standard treatment which has proved most satisfactory and successful in cases not too long neglected.

The treatment was formulated to meet a definite pathological condition. It aimed, first, to establish ample drainage of the large infected cavity, with full knowledge that the infecting organisms would rapidly die out. Secondly, it aimed to obliterate the cavity which had resulted by reason of the compression and misplacement of the thoracic organs. As an adjuvant to these two aims, irrigation has from time to time been in vogue, but by most surgeons discarded. There has also been substituted for an ample drainage opening various types of intermittent or continuous suction, with the hope that the negative pressure thus established would tend to draw out the compressed lung, and thus hasten the cavity obliteration. This negative pressure has been obtained by elaborate apparatus consisting of a canula or tube inserted into the thorax so snugly that no air leakage could occur around it, and a pump or syphon suction. It has had a very thorough trial by many competent men, and has met with some success. More often than not, however, it failed to accomplish the desired end, either because the connection through the chest wall did not remain air-tight, or drainage was incomplete. In part its use is based on a misconception. The belief has been more or less prevalent that when an open thorax is present, the lung, unless adherent, completely collapses because of the tension of its elastic fibres unopposed by a negative pressure around it. This only occurs when the pleural cavity of the lung is not changed by inflammatory exudate, and the opening in the chest is so large that the inflow of air through it in inspiration is equal to that going through the glottis. Graham and Bell [2] have proved this experimentally, and have demonstrated that an opening 2 inches by 4.1 inches can be borne without complete collapse of the lung.

This means that with any smaller opening, each inspiratory effort tends to produce a negative pressure, and by just so much tends to draw air through the trachea into the lung on the affected side. Graham [3] demonstrates that it goes in equal amount in each lung in the absence of inflammatory fixation of the mediastinum. Therefore, if ample drainage is provided through an opening not too large, and this opening is kept largely obstructed on its outer aspect by the application of copious dressings, ideal conditions are present to overcome the infection, and ultimately force the lung to reëxpand to its normal extent. The use of forced inspiration and expiration is a great aid to this process, and is habitually

[2] Amer. Jour. Med. Scien., Dec., 1918, No. 6, vol. clvi, p. 839.
[3] Loc. Cit.

obtained with the blow-bottles. That a proteolytic agent like Dakin's solution intermittently diffused throughout the cavity is an aid is beyond question. It removes the substances on which bacteria live, and at the same time kills bacteria with which it comes in contact, and by just so much shortens the period of infection. It also may aid in digestion of the inflammatory exudate on the pleura, and thus allow earlier lung expansion. Hence, the standard treatment of this disease, gradually evolved over many years, is seen to be based on a very sound reasoning, and succeeds because it accurately combats pathological conditions.

As encountered, however, during the past two years, the disease called empyema has differed from this simple form in many important particulars. It also has been treated by men who have never studied the underlying principles of this standard treatment, and consequently applied it to a very different condition, with inevitable but unexpected failure. To the initiated, the report of a commission was not needed to point out that a wide-open hole in the chest of a man desperately sick with a streptococcus toxæmia, was going to add to rather than diminish the cyanosis from which he suffered. The mechanical embarrassment under which his respiration labored could be as effectively relieved by a simple aspiration. So long as the fluid could be drawn through a needle, this relief could be afforded as often as was required. His toxic condition was also to a degree lessened by this procedure, but this was of minor importance, because the source of the absorbed poisons lay in the lungs, or other tissues, and not in the pleural effusion. Later, if his strength withstood the ordeal, and the purulent exudate continued in the pleural space, the standard operation was successfully performed. In many instances this was not needed, and the infected pleura returned to the normal with no other treatment than aspiration, either intermittent or continuous, sometimes aided by flushing with Dakin's solution through the aspiration apparatus. This was not only feasible, but successful, because of two factors. The fluid throughout the early stages is thin and relatively poor in coagulable substances. Therefore, the chest cavity can be completely emptied through a relatively small canula. The streptococcus hæmolyticus is not a deep invader. It lies close to the surface, and in many resistant individuals, though primarily very virulent, tends to die out. Hence, we repeatedly receive reports of such cases getting well. False inferences were drawn, and a widespread belief exists that the proper treatment of empyema lies in suction evacuation of pus and delayed or no operative treatment. Due consideration is also not given to the fact that no small number of these cases recovered when the exploring needle withdrew a cloudy infected fluid, and no operative treatment of any sort was employed.

It is not difficult to logically explain wherein the less radical forms of treatment fail to meet the requirements of the pathological conditions in a true purulent pleural effusion. In the first place, they do not satisfy the

principle of adequate drainage of an active suppurative focus. This law can only be ignored with due caution. A suppurating surface as extensive as the pleura must be given constant and continuous opportunity to be freed from contact with the products of its lesion, if healing is to occur. If by chance—and I believe it is chance—the constant suction keeps the cavity empty, there is always a possibility that a latent infection will subsequently light up and the lesion occur. In the second place, all treatments of this character are based upon the erroneous idea that the expansion of a lung whose thoracic wall is open cannot take place. Wherein this view is erroneous has already been explained, and as the suppuration grows less, and the drainage opening is permitted, day by day, to contract and is kept more continuously covered with a copious dressing, by a corresponding amount does the expanding force of respiration increase. There is thus an orderly return to the normal, the suppuration lessening as the lung, freed from its crippling thickened pleura, gradually expands, so that full expansion and a clean healthy pleura occur at the same time.

The expected time for the accomplishment of this is from four to five weeks. Any attempt to shorten it by chemical sterilization of the cavity and a tight secondary suture of the opening is doomed to such frequent failure that it cannot be recommended. The explanation is not difficult. Assuming that our bacteriological observation has covered every nook and corner of the infected portion of the pleura—an assumption that takes more credulity than I possess—a closure of the opening leaves a dead space within the thorax. The damaged lung does not immediately leap out to fill this, even under conditions of normal chest expansion. The almost invariable result is a serous effusion of the lung. The conditions are, therefore, ideal for a recurrence, namely, a pent-up collection of serum within a serous-lined cavity which recently has been the seat of a virulent infection. The fact that sometimes success is obtained and a final cure results in three or even two weeks does not alter the fact that it is obtained in spite of a violation of sound principles. The failures are more than enough to condemn the procedure, and when they do occur are more difficult to cope with than was the primary disease.

The purpose of the arguments herein presented is to call attention to the fact that if the experiences of the past two years are made the basis of the standard treatment of empyema, under conditions of pulmonary disease less abnormal than those existing during this trial, a distinct step backward will have been taken.

Reading of the history of empyema during the past five decades shows that from time to time there have arisen advocates of the so-called less radical forms of treatment, who have enjoyed a short period of success. Failure, however, always succeeded this period. Gradually, through the constant teaching of thinking masters, this disease has recently been handled along sound lines of therapeutic technic, founded on a full com-

prehension of its pathology. Any falling away from this will only result in a period of again learning old lessons with its resultant suffering.

Our argument may be summed up in the statement that no form of treatment for empyema which disregards the thorough drainage of the chest cavity by a rib resection, and the gradual reëxpansion of the lung by respiratory effort, meets the requirements. Other means will cure a certain number of cases, particularly in such times as the disease occurs in abortive forms, which it has done during the past two years.

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# ABSCESS OF THE LUNG*

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THERE exists in the literature some confusion as to the lesions included under the term abscess of the lung. In this communication a definition is employed which it is believed accurately describes the lesion, and at the same time is comprehensive enough to include the associated necrosis which so often is a part of the lesion.

Abscess of the lung means a collection of pus within the destroyed lung parenchyma; that is, it must be outside the lumen of the respiratory tree. Dilatation of the bronchi with a purulent inflammation of the mucosa and an excessive expectoration of foul sputum is not to be confused with abscess. This lesion—bronchiectasis—may coincidently be present, but is not necessarily so. Surrounding the abscess—really a portion of its wall—there often exists a destruction of lung tissue which may be somewhat massive and approach gangrene. One must, to a certain extent, be empiric in delimiting this lesion from a true gangrene. When the condition has resulted from bacterial invasion, *via* the respiratory tract, and is early manifest by the suppurative process, the term gangrenous abscess is accurately descriptive. Gangrene should be reserved for a massive destruction of lung tissue, either from true circulatory disturbance, or from such an overwhelmingly virulent infection that the lung tissue is killed in mass by toxins or vascular plugging before there can be a sufficient reaction to generate pus. If this division be followed, the number of cases of lung gangrene reported will be materially lessened, and a better understanding of the pathological processes be possible.

A case of true gangrene—the only one coming to my personal attention—has recently been reported to me through the courtesy of Dr. Lincoln Davis, of the Massachusetts General Hospital. A child received a penetrating wound with a crochet needle into the upper right lobe of the lung. Two days later she began to suffer pain and marked swelling around the site of puncture which rapidly increased up to the time of her admission to the hospital, one week after the injury. She was then very sick, the manifest signs being an emphysematous cellulitis in the neck and upper chest, with evidence of a hæmo-pyo-pneumothorax. Thoracotomy was performed. Death occurred the following day. Autopsy showed the entire upper lobe of the lung converted into a necrotic sac

* Read at a joint meeting of the New York Surgical Society and the Philadelphia Academy of Surgery, February 2, 1920.

containing brownish opaque fluid. There was neither the surrounding inflammatory zone nor the pus content of an abscess formation.

Dr. Albert Frost, of the Interne Staff, has made the following summary of autopsy findings from the protocols of six thousand autopsies at Bellevue Hospital for the purpose of studying the relations in this type of lesion. There have been 148 cases with the anatomical diagnosis of lung abscess and gangrene of the lung. Abscess and gangrene are included in this summary under one head, because of the fact that so many of the cases of so-called gangrene of the lung cannot be differentiated from abscess.

Of the 23 cases with an anatomical diagnosis of gangrene, only 7 could be definitely spoken of as a true gangrene from the descriptions.

Of these 148 cases there were 50 which should be regarded as clinical abscesses, in that the abscess was of such size that it could have been detected before death, either by physical examination or by X-ray. Of these clinical abscesses there were 25 situated in the upper lobes, 22 in the lower lobes, and 3 in the middle lobe.

Other interesting data are briefly summarized in the following table:

| | |
|---|---|
| Subpleural abscesses associated with empyema | 34 cases |
| Abscesses mentioned as having ruptured into the pleura in which there was an accompanying empyema | 12 cases |
| Empyemas mentioned as draining through the trachea | 2 cases |
| Abscesses mentioned as rupturing into bronchi | 15 cases |
| Pus from abscess mentioned as having foul odor | 47 cases |
| Abscess result of necrosis of infarcted area | 17 cases |

The etiological factor in the production of these abscesses, including both the clinical and pathological lesions, was, so far as possible, determined from the associated autopsy findings. Only those cases in which the cause was evident are included in the following:

| | | | |
|---|---|---|---|
| Bronchopneumonia | 29 | Septic endometritis | 7 |
| Lobar pneumonia | 18 | Infective endocarditis | 6 |
| Pyæmia | 15 | Acute suppurative otitis media | 5 |
| Septicæmia | 11 | Thrombosis pulmonary artery | 4 |
| Thrombosis in peripheral venous channels (sinus, jugular and inferior vena cava) | 8 | Purulent bronchitis (cause or effect) | 3 |
| | | Tracheotomy | 2 |

In the literature the differentiation between abscess and gangrene is often made from the odor of the sputum and the pus. Exceedingly foul pus is made to connote a gangrene without regard to the pathology. This, obviously, is incorrect, as is proved by the clinical and pathological cases described. In several of these the pus was stinking, and yet the evidence is conclusive that no true gangrene was present.

While abscess of the lung may result from other sources, the great majority have as a direct antecedent some type of respiratory infection, if, in such infection, the aspiration inflammations be included. In the literature the statement is found that among these the true pneumococcus lobar pneumonia is the most common antecedent. We have not found

this to be the case, either actually or relatively. Of 13 cases, associated with a pulmonary infection, observed clinically, 10 of which will be analyzed in detail, only 3 followed this type of infection. What is still more significant, in each of these three, secondary invaders were found in the abscess content, and the pneumococcus apparently had no part in abscess formation.

MacCallum, in a personal communication, says, "I am skeptical about those abscesses said to occur in the course of a pneumococcus lobar pneumonia. At least, they never look like abscesses, but like areas of more advanced destruction with no special limitation." He expresses the belief that even these are due to secondary invaders; an opinion amply sustained by our study.

In 770 consecutive cases of pneumococcus lobar pneumonia admitted to the Rockefeller Hospital, only 2 developed lung abscess, and each of these showed other infecting organisms. One of them completely recovered from the lesion in the lobe first involved, and later the abscess containing no pneumococci, formed in the other lung, in a part where the evidence of lobar pneumonia was very recent and scant. In this series there were two others showing a pneumococcus infection, but the diagnosis of a lobar pneumonia could not be substantiated by the physical signs or the radiograph. During the same period there were 140 cases of bronchopneumonia admitted, one of whom developed a lung abscess.

The entire number of abscesses observed in this hospital has been 9, the remaining 6 being divided as follows: 2 followed previous tonsillectomies with mixed infections; 1 occurred primarily with a staphylococcus aureus infection; 2 occurred primarily with a very mixed bacterial infection, and 1 resulted as a late manifestation of a staphylococcus aureus pneumonia. Our studies lead to the conclusion that the staphylococcus aureus is an important agent in abscess formation.

Great interest attaches to the subject of the pathogenesis of the abscess. In this connection the recent studies of Cecil and Blake are important. These authors found in their studies of the pathogenesis of pneumonia and other pulmonary infections that the inflammation in the lung parenchyma, following injections of virulent cultures into the trachea of monkeys, preceded by some hours the exudation in the air vesicles.

Inasmuch as the infecting organisms must sooner or later invade and break down this interstitial tissue, if an abscess is to result, this very early invasion throws light on the occurrence of a primary abscess, that is, pus formation before there is any pneumonic consolidation. In fact, in some cases, such consolidation may never appear. More often, however, the presence of a true consolidation may be demonstrated. The changes from this condition with the vesicular exudate and the interstitial inflammation to abscess formation are to some extent elucidated by the study of the pneumonic lung, particularly when there exists a mixed bacterial flora.

Many cases of pneumonia coming to autopsy exhibit areas in which the interstitial spaces are packed with the products of the pneumonic inflammation, the vesicle walls are more or less destroyed, and the lung substance is converted into an acutely inflamed zone showing foci of necrosis. In many instances these foci have progressed to a farther stage and liquefaction is present, *i.e.*, a beginning abscess (Figs. 1 and 2). The majority of such foci are very small, and while pathologically they are abscesses, this could not have been determined clinically. It is to be assumed that, had such cases survived, there would have occurred, in some, at least, a farther development, and clinical evidence would have been present. Chickering and Park found in the lungs of patients dying from staphylococcus aureus pneumonia, multiple abscesses varying in size from a millimetre to a centimetre. The content varied from a necrotic mass to a thick, greenish, yellow pus. In no instance was the abscess large enough to have given clinical signs.

All these studies emphasize the belief that lung abscess is a very important possibility much more often than is realized. We have no knowledge of how frequently these small focal abscesses form and undergo resolution and drainage, but this evidence is in favor of its frequent occurrence. We are not informed as to the causes which bring about their continued growth into large abscesses. One is compelled to fall back upon the unknown factor of resistance and virulence, with, in addition, the factor of a better or poorer drainage *via* the bronchioles. Study of the bacteriology yields the information already mentioned. Abscesses are encountered clinically, following all types of pneumonia, but the rule is to find a secondary invader, such as staphylococcus or streptococcus, occurring alone or in conjunction with the influenza bacillus. All these organisms have been found in the sputum of patients suffering from lung abscess. On the other hand, all types of lung infections regularly occur without the development of lung abscess. The clinical facts on which to base a belief that the ordinary pyogenic bacteria, particularly the staphylococcus aureus, are more prone than other organisms to produce a lung abscess are given above. It is to be emphasized that a staphylococcus aureus infection may produce an abscess without a true pneumonia. A well-marked abscess may occur almost with the inception of this infection, and be fully developed within a few days of the onset of the illness. Such a lesion is the primary lung abscess already mentioned.

There is, in every case of abscess, an exit for the fluid pus *via* the vesicles and small bronchioles. This drainage, however, is often inadequate, and following the law of all suppuration, the process extends along lines of least resistance. Abscess cavities, from five to ten centimetres in diameter, up to an entire lobe, may thus be formed. A fluid content of several hundred cubic centimetres is not uncommon. Ultimately, a larger bronchus is opened to it, drainage is free, and the complete pathological picture of the abscess is present. Often several large bronchial openings into the abscess are present.

An abscess in the more superficial parts of the lung tends to reach a considerable size before it lies in relation to a bronchus of sufficient lumen to afford an avenue of adequate drainage. In the deeper parts, on the other hand, such bronchi are more numerous, and it is possible for drainage to be more complete (Figs. 3 and 4). This is an important fact from a therapeutic standpoint. It also has a most important bearing, as we believe, upon the occurrence of empyema and its occasional drainage through the lung and trachea.

When the abscess is fully established, as seen, for instance, at operation, its wall is a ragged surface of necrosing lung tissue around which, microscopically, are found œdema, leucocytes, dilated and thrombosed blood-vessels and bacteria, all of which pack the air vesicles as well as the interstitial space. Its outline is often irregular, giving the impression that several foci of suppuration have coalesced into one abscess. Between these diverticula the lung substance may be dead in considerable areas. When the infecting organisms are unusually virulent a surrounding gangrenous condition may supervene. Putrefactive organisms gaining entrance from the mouth to such areas produce a putrid mass. Such lesions are not uncommon, and should be designated as already discussed, as gangrenous abscess rather than lung gangrene.

Since, whatever the cause of the abscess, there exists an antecedent inflammation, the surrounding zone is always well marked. It is emphasized in abscesses secondary to the pneumonic infections, because such abscesses occur in portions where resolution has been incomplete and the interstitial inflammation is marked. In studying the physical signs of abscess formation and in reading radiographs, this zone must be given due consideration. It often acts as a very troublesome mask to a proper diagnosis.

The following case[1] illustrates the pathological and clinical development of an abscess as the sequela of a true lobar pneumonia, where the pus formation was due to a mixed infection.

> On February 6, 1914, the patient, a male, aged forty-two years, developed a left upper lobar pneumonia with typical signs and X-ray findings. The sputum was rusty from the onset. On admission two days later there was isolated from the sputum a Gram-positive diplococcus, a Gram-negative capsulated bacillus, the Friedlander and the influenza bacillus. On the fourth day of the disease there was elicited a flat note over the centre of the consolidation. Resolution and deffervescence failed, and on February 21st there were made out the signs of cavity formation, but the X-ray failed to demonstrate any change in the shadow.

[1] All the clinical cases herein reported, with the exception of the last one, were observed and treated at the Rockefeller Institute Hospital. I desire to express my thanks to Dr. Rufus Cole for the privilege of having treated them and including them in the report.

On February 27th there appeared the first expectoration of pus, 250 c.c., from which the same organisms as found in the early sputum were isolated. The physical signs and the X-ray now fully demonstrated the presence of a cavity in the centre of the upper left lobe. His general condition remained excellent and operation was delayed until March 7th with the hope that sufficient drainage, *via* the trachea, might result in a cure. This failing, the surgical procedure followed in all the cases was undertaken. The exact position of the cavity was determined with the exploring needle, and under novocaine anæsthesia a portion of the underlying rib—in this case the fourth to the left of the sternum—was resected. The two pleural surfaces being found adherent, they were incised, and by blunt dissection the abscess cavity was opened. It was about 10 cm. in diameter and pathologically showed the typical lesion described above. The pus contained the organisms above named, with the exception of the pneumococcus. Tube, and later vaselined gauze, drainage was established, and healing was complete on May 8th.

The course of the abscess development is in this case sufficiently clear by reference to what has already been said. The severity of the interstitial infection produced a local inflammation which failed of resorption (Figs. 1 and 2), and in the course of two weeks pus formation was present, and a week later a bronchus of sufficient size for internal drainage was opened into.

This case contrasts quite sharply with the following, who developed a well-marked left lower lobar pneumonia on April 20, 1914. On admission three days later the sputum showed a pneumococcus and a Gram-negative bacillus. The process in this lobe went on to a normal resolution on the seventh day, with a normal temperature. On April 25th, however, pain and friction râles developed over the right upper lobe. On May 5th the temperature rose to 103.4°, and signs of consolidation developed in the right lung anteriorly. An exploratory needle puncture in the third space, 5 cm. from the right edge of the sternum, entered a pus and air cavity. Cultures from the pus gave a pure growth of hæmolytic staphylococcus aureus. Operation showed an abscess which was multilocular, each focus containing only a few c.c. of pus with an extensive surrounding zone of necrotic lung. A cure resulted in about two months.

This case illustrates the rôle of the staphylococcus aureus in abscess production. The lobe first attacked followed the normal course of a pneumococcus lobar pneumonia, but another lobe attacked by the staphylococcus promptly passed into the suppurative condition and developed an abscess.

A third case presents still another phase of the subject.

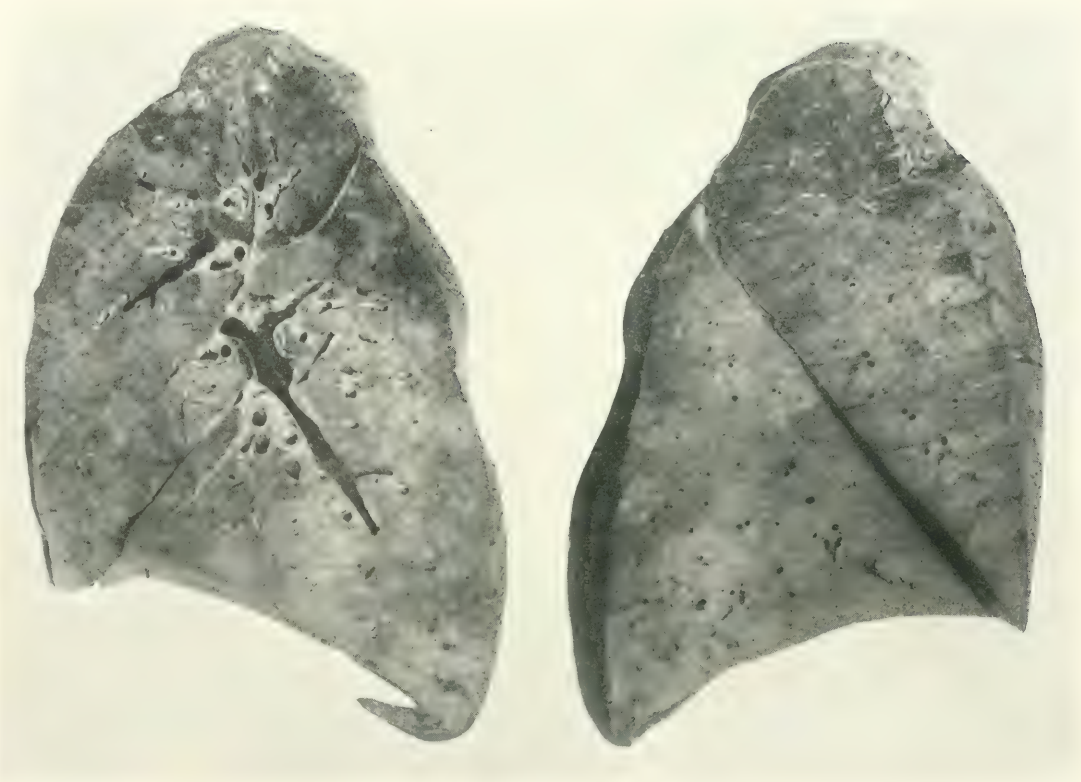
The patient, a male aged twenty years, was admitted to the hospital on April 11, 1914, with the history of having had a cold for

FIG. 1.—Lobar pneumonia, showing the areas of necrosis, which are the starting points of abscess.

FIG. 2.—Influenza pneumonia, showing a necrosis beneath the pleura with a nearby large bronchus. This type of lesion going on to abscess formation may also produce an empyema which will drain through the abscess cavity and the bronchus.

FIG. 3.

FIG. 4.



FIGS. 3 and 4.—A lung distended to the normal inspiratory extent and hardened in formalin. Fig. 3 shows the large bronchi ("drainage tubes") at the junction of the middle and deep thirds, while Fig. 4 shows the absence of these at the junction of middle and superficial thirds.

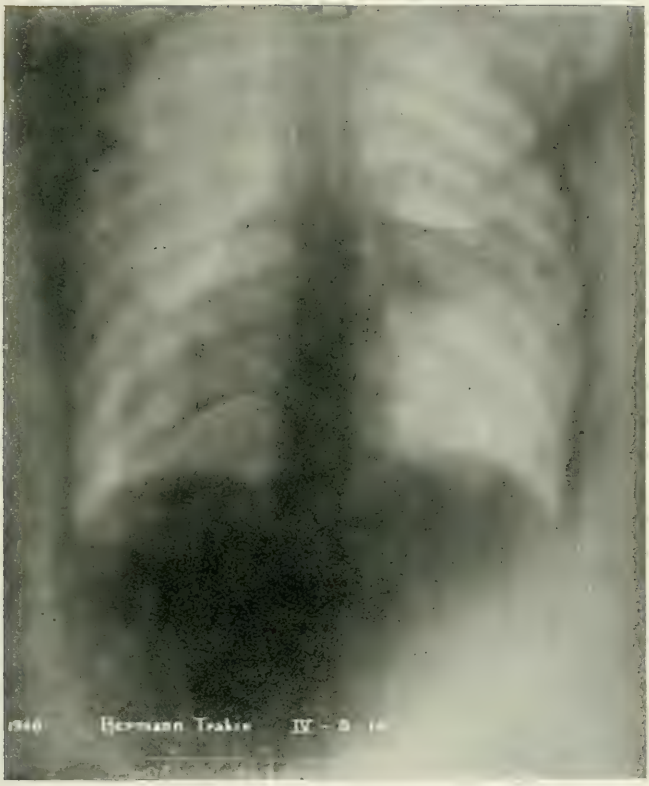
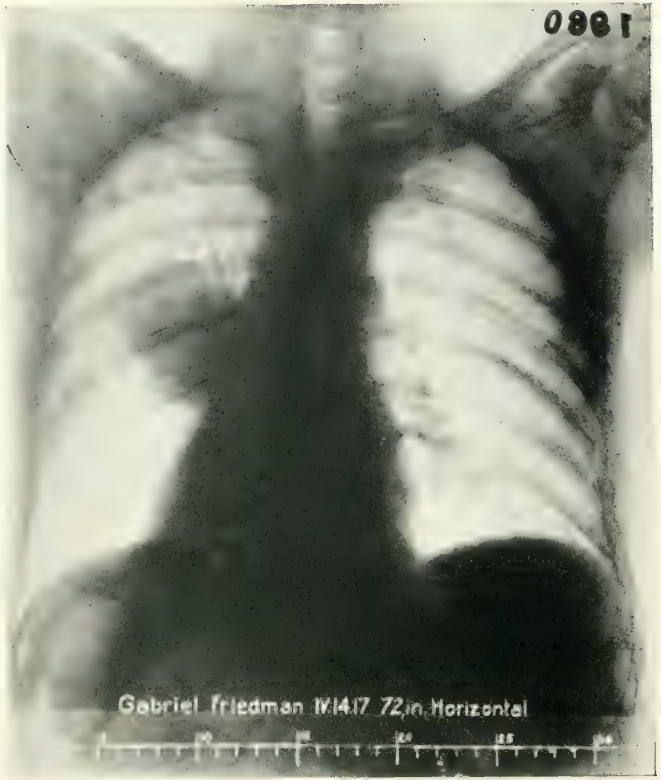


FIG. 5.—A typical shadow of an abscess cavity containing pus below and air above.




FIGS. 6 and 7.—A deep-seated staphylococcus abscess slowly working toward the anterior wall in spite of free bronchial drainage.

two days and a chill and sudden pain in the right chest two days before admission. He suffered from a dry cough with occasionally the expectoration of a little mucopurulent sputum, which contained a non-hæmolytic streptococcus, a pneumococcus, and a Gram-negative bacillus, the latter predominating. There were no evident signs of consolidation made out at any time during the nine days he remained in the hospital. The temperature ranged from 100° to 102.8°, pulse about 80, and respirations 30. The X-ray on the third day following the chill showed a denser shadow corresponding to and extending immediately around the right hilus.

On the ninth day of the disease there occurred free expectoration of 100 c.c. of brownish-gray pus which contained characteristic elastic fibres arranged partly in alveolar form. These were recovered from a mouse inoculated with this pus: (1) Pneumococcus mucosa, bile soluble. (2) Pneumococcus IV. (3) Streptococcus hæmolyticus. (4) B. Influenza.

The X-ray (Fig. 5) now shows a distinct abscess cavity with a very limited surrounding zone of consolidation containing free fluid and air. This cavity was not determined by the physical signs.

An exploration needle introduced deeply into the substance of the lung through the sixth space, near the angle of the right scapula, withdrew pus of the same character and containing the same organisms. The patient declined operation and made a complete recovery.

This condition in which the abscess is an early manifestation of a deep-seated lung infection is contrasted with the more superficial abscesses. In the former the drainage may prove adequate because of the immediate vicinity of the large bronchi which act as efficient drainage tubes. In the latter extensive destruction of lung tissue must take place before such tubes are reached, and hence spontaneous recovery is less possible (Figs. 3 and 4). Not all deep-seated cases escape without operation, however, as is shown by the following:

A man, aged thirty-six years, was admitted to the hospital April 13, 1917. Two weeks prior to admission be caught cold and had a sticking pain in the *right* chest. He states there was cough and bloody sputum, but no fever. He was only absent from work for three days. A few days later there was a recurrence of illness with severe coughing, blood-tinged sputum, and sticking pain in the *left* chest. There was no chill and he states no fever until four days prior to admission. No history of having inhaled any irritating gas or foreign body could be obtained.

The physical examination revealed a soft friction rub in the left axilla, and below the angle of the scapula posteriorly there was a slight exaggeration in whisper. Elsewhere the lungs showed no abnormal signs. The remainder of the physical examination was negative. No portal of entry for infection could be found. Blood culture was sterile with 10 c.c. in 150 c.c. broth and 2 c.c. on 10 c.c. agar plate.

The patient appeared acutely but not seriously ill. Temperature, 102.8°; pulse, 95; respiration, 28; white blood-cells, 40,000. The only change in the general condition or physical signs, until the seventh day of illness, was the development of slight dullness over the left mid chest posteriorly. On that day there was severe coughing and suddenly purulent sputum was expectorated in very large amounts. It was greenish brown in color. Smears showed many varieties of bacteria. Injected into a mouse it yielded staphylococcus aureus in the heart's blood. Dullness with sonorous and sibilant râles were present over the left mid chest anteriorly.

Diagnosis of lung abscess with free bronchial drainage was made. It probably was of staphylococcus origin and lay deep within the middle portion of the left lung. The patient was kept under observation for ten days, because his general condition remained satisfactory, the abscess was draining freely and a serious question was present as to whether the better operative approach was from before or behind.

During this period the temperature ranged from 100° to 102.5°. Pulse 80 to 100. Respiration 22 to 32, and the blood count 40,000 to 50,000 with about 88 per cent polymorphonuclears. The physical signs changed only in that dullness developed anteriorly over the left mid chest and percussion here elicited tenderness. The sputum was abundant, 190 c.c. on one occasion. It was almost pure pus, greenish in color, with tinge of blood, and of very foul odor. Staphylococcus aureus was recovered from the heart's blood of the mouse on several occasions following injections of purulent sputum. No source of a staphylococcus aureus could be found anywhere in the body. No tubercle bacilli were found.

The X-ray plates showed the development of the abscess and its approach to the anterior chest wall. They gave no evidence of a pneumonia or a tuberculosis (Figs. 6 and 7). The exploring needle inserted about the eighteenth day of the disease in the third intercostal space, at the outer border of the left pectoral muscle, entered the cavity and withdrew very foul, thick, brownish pus.

Under local anæsthesia 6 cm. of the third rib at this point was resected and immediately beneath the two layers of the densely adherent pleura and a thin shell of remaining lung tissue was found an abscess cavity 15 cm. in diameter contatining about 250 c.c. of the same foul pus. Internally, the cavity seemed to be bounded by the pericardium, but on all other surfaces there was comparatively healthy lung tissue. The pleural cavity was not infected. The abscess was in the inferior portion of the upper lobe. So far as could be ascertained the post-operative behavior of the lung condition was satisfactory. Drainage continued free and there was no other evident involvement of lung tissue. The patient, however, lost weight and strength, refused to eat, and died without evidence of sepsis three weeks following operation. No autopsy was granted and the immediate cause of death was not determined.

This case is of the type of primary abscess with the staphylococcus aureus as the exciting organism. The X-ray (Fig. 6) failed to show the usual shadow of a pneumonic consolidation. The abscess ruptured into a large bronchus with a resultant expectoration of a large amount of foul pus on the seventh day of his illness which is too early for the development of the abscess through a preceding stage of consolidation. Notwithstanding the deep-seated position of the lesion, and its early drainage by the tracheal route, it continued to extend toward the pleural surface, and obviously was not destined to recover without external drainage.

From the early sticking pain in the left chest and the friction rub heard in this axilla, it is evident that the original infection involved superficial as well as deep portions of the lung, but with not sufficient lesion to cast a shadow with the X-ray.

Suppuration occurred first in the more seriously damaged central portion and later extended into the superficial part where drainage was less complete. This was proved by the fact that at operation the two pleuræ were adherent and thickened, although the abscess itself was still situated some distance below the surface.

Other organisms than the staphylococcus aureus are capable of producing a pathological condition with similar clinical manifestations to those just mentioned, as is shown in the case of a man aged twenty-eight years who was admitted to the hospital on April 6, 1914. His illness began on April 2d with a chill and pain in the right chest behind. He immediately (?) began to expectorate large amounts of foul pus.

The physical signs were not marked, though some dullness existed with diminished fremitus and breath sounds over the lower right chest behind.

Two days after admission—the sixth day of his illness—an exploratory puncture deep into the right lung yielded very foul pus. Operation revealed a markedly inflamed lung with many small abscess cavities underlying the adherent and thickened pleuræ. The whole area of disease was evidently undergoing a breaking down suppurative process. The responsible organisms in this case, as determined both from the sputum and the pus, were Gram-positive cocci, Gram-negative fusiform bacilli, Gram-positive diplococci, and a short-chained coccus. The Gram-negative organisms were obtained only under anaërobic conditions. Healing was delayed until the twelfth week, owing to the presence of an open bronchial fistula, which only closed after nine weeks.

A case of true staphylococcus aureus pneumonia, with resultant multiple abscess formation—the type described by Chickering and Park—going on to recovery without operation, is illustrated by the following. A man, aged twenty-four years, was admitted to the hospital with this history. His illness began with an ordinary cold, after three days of which the patient had a chill and severe pain in the right side of the chest. He was admitted to the hospital

fifteen hours later. At this time he appeared very sick. Temperature, 105°; pulse, 124; respiration, 34; lips cyanotic. Examination showed evidence of a beginning consolidation in the right axilla. Sputum on culture yielded a pure growth of hæmolytic staphylococcus aureus. Blood cultures were negative.

On the fourth day of his disease, which followed the course of a severe pneumonia, the patient coughed up a mass of homogeneous, hemorrhagic sputum, swarming with staphylococci. The condition continued unchanged up to the eighth day. Exploratory puncture then yielded 10 c.c. of thick, grumous, chocolate-colored pus, smears of which showed only staphylococci.

On the thirteenth day the patient first began to expectorate freely pure pus, but in small quantity, after which there was a suggestion of amphoric breathing and loud râles in the posterior part of the right axilla. He remained acutely sick during this period, and developed foci of suppuration in two of his fingers and also in the chest around the site of the needle puncture. Other punctures into the lung were done on the twenty-first and twenty-seventh days, but in each instance the needle, as at the first puncture, passed into very solid lung tissue and only withdrew a few drops of pus, and in one instance entered a foul-smelling air cavity. During this period the amount of foul, purulent sputum gradually increased, but was not excessive until the thirty-fifth day, when, after coughing, there was a sudden gush of very foul-smelling pus which was projected outward like vomitus. From this time forward the progress was satisfactorily toward complete recovery, there being a gradual healing of the lung process. Complete recovery was established on the ninety-second day of his disease. Operation was deemed unwise in this case, because the process was an unresolved staphylococcus pneumonia with many small necrotic foci with which surgery would have found great difficulty in dealing. When the large abscess finally developed it promptly reached a large bronchus and a change toward recovery was immediately instituted.

Mention has been made of the relation of empyema secondary to abscess formation, and subsequent drainage of both the abscess and the pleural suppuration through the tracheal tree. I incline to the belief that this is the usual sequence of events when an empyema drains in this way. An abscess of considerable size develops in the superficial part of the lung, and failing to reach any bronchus of size, there is no expectoration of pus. Such a lesion gives no physical signs to differentiate it from the surrounding consolidation, and so is not diagnosed. In its extension it finally reaches the pleural surface, ruptures through, and produces a secondary empyema. The physical signs of the latter completely mask the abscess, and the case appears as an empyema only. The extension of the abscess, however, is also toward the deeper portion of the lung, and in this direction a large bronchus is ultimately reached, and there results a free expectoration of pus. This is interpreted as the "rupture

of an empyema " into the lung which is obviously an incorrect deduction. The actual lesion is a lung abscess reaching an outlet in two directions—first, into the pleura, and second, into the bronchus. Often expectoration of pus is not a marked feature, and operation on the empyema is undertaken prior to this secondary exit. The communication into a bronchus, however, exists, and following operation, one essential for the cure of the empyema is lacking, namely, the coincident expansion of the lung as the suppuration in the pleura is overcome. The open bronchus produces a continued internal pneumothorax, the lung fails to expand, and cure of the empyema is delayed long after the proper interval. This is often one of the underlying causes of persistent sinus following an operation for what was believed to be a simple empyema.

The employment of Dakin's solution for cleansing the pleural cavity after rib resection has demonstrated the presence of these coexisting lesions not infrequently. When present, the patient promptly smells and tastes the chlorine, and in many cases violent pulmonary irritation is set up with uncontrollable coughing. This never results when this solution is used in a simple uncomplicated empyema. Its appearance is proof that one is dealing with the condition under discussion, and in my belief, the use of Dakin's solution must never be continued, no matter how efficient one may have found it in the uncomplicated cases.

This occurrence of an empyema masking completely the presence of a large abscess of the lung was illustrated by two cases in this series.

In the first the illness began with pain in the right chest and the expectoration of foul pus. He was admitted to the hospital two weeks later, during which time the later symptoms had continued.

Examination by exploratory puncture showed that the right chest contained thick, yellowish-green, foul pus, similar in appearance to the sputum. Both contained Gram-positive and Gram-negative cocci and Gram-negative bacilli. Injected into a mouse there were isolated Gram-positive diplococci with large capsule (pneumococcus mucus). The exudate agglutinated with antipneumococcus serum III. The X-ray showed the shadow of a pleural effusion. Operation revealed a large abscess containing very foul pus in the middle of the right lower lobe. There was also a very thick fibrous purulent exudate in the pleura overlying this. The patient recovered, but still had a small clean bronchial fistula when last reported.

The second case is of unusual interest. The patient, an officer, aged twenty-three years, with the A. E. F., developed an arthritis in August, 1918, while on duty in the advanced zone. At about the same time he was slightly gassed with chlorine. He was sent to a rear hospital where, on September 15th, under local anæsthesia, a tonsillectomy was done. A month later he suffered from an attack of influenza and pneumonia. There is some evidence that prior to this he was ill with a pulmonary infection and at times expectorated pus, sometimes a " half cupful in a day." He remained ill through

the winter and was finally operated upon in March, 1919, for empyema. He was told that two quarts of pus were evacuated. Dakin solution was instilled into the pleural cavity on one occasion and he continued to "taste it for a week," so that it was not employed a second time. In the course of ten weeks the operative wound closed. On June 30, 1919, the X-ray and the physical signs showed that he had a complete pneumothorax, the lung having contracted to a small mass near the root and along the left border of the pericardium. The operative wound was still closed and he was without constitutional symptoms.

In August, 1919, he became acutely ill and coughed up large amounts of somewhat foul pus. There was no pus in the pleural cavity as demonstrated by exploratory puncture, though after four weeks the sinus opened and for a short time there was a moderate discharge. The sinus closed, the pus expectoration ceased, and in December an X-ray showed the lung expanded to fill almost the entire chest. There was a recurrence of purulent expectoration in January. At this time the X-ray and the physical signs demonstrated a cavity in the middle of the left lung posteriorly. The expectoration subsided in three or four weeks, and in April an X-ray and the physical examination failed to demonstrate any cavity formation.

The course of the disease in this case seems to have been an abscess, probably following the tonsillectomy, which ruptured into the pleura, producing the empyema. This was operated upon and the opening closed, but the lung failed to expand because of the internal pulmonary fistula which kept up a continued pneumothorax. This condition is evidenced by the fact that the chest wall instead of retracting, as is usual with a collapsed lung, expanded to a marked degree, as is amply illustrated in the X-ray by the wide separation of the ribs, a finding called to my attention by Dr. Codman, of Boston.

Subsequently the abscess discharged through the trachea, its fistulous opening closed, and gradually the lung expanded to its full extent with a resulting cure of the complex lesion.

The infecting organism in this case was found in every instance to be the streptococcus hæmolyticus.

This analysis of these pathological and clinical observations is believed to fully justify the findings included in the introductory remarks, namely, that the pneumococcus is not an important factor in lung abscess; that the staphylococcus aureus is often responsible; that abscess of the lung frequently is a primary lesion in that a true pneumonic consolidation as connoted by the name pneumonia does not precede it; that abscess of the lung includes in its pathology a marked degree of surrounding necrosis, or even massive gangrene, and that when an empyema ruptures into the lung and discharges through the bronchus the original lesion was a lung abscess which, by its extension, finally found two outlets for its purulent content.

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# THE CONTRIBUTION OF THE WAR TO THE SURGERY OF THE KNEE-JOINT*

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The war having ended, it should be our immediate aim to consider the new surgical chapters written in the great conflict, and to adapt such of them as we may to the surgery of civil life. One hears occasionally that some men returning from abroad have brought back no new thing to civil surgery, but such a barren result must mean a limited experience or a non-receptive mind. Among the many important contributions may be mentioned: The Principles of Débridement in Wounds; The Sterilization of Infected Wounds; The Possibilities of Primary and Secondary Suture; The Vast Accumulation of Data Upon Fractures and Osteomyelitis; The Large Experience in Nerve-Suture Work; The New Chapter in the Radical Srugery of the Lung; The Demonstration of the Non-Wisdom of the Expectant Treatment of Abdominal Wounds, the First War to Accomplish this Result; and lastly, as important as any other contribution, The Establishment of the New Method of Treatment in Joint Surgery.

The object of this paper is to place concisely before the American surgeon, the real facts concerning the great addition, made by the war, to the surgery of the knee-joint. Willems, the Belgian surgeon, advocated and began to practice in 1915 the treatment which now bears his name. A complete description of this method is scarcely necessary. In September, 1918, the writer published a detailed account of the method, the paper having been written the preceding January, but it was delayed in transmission. It may perhaps be well, however, to briefly summarize the basic principles of Willems' treatment.

Willems' treatment of a wound of the knee-joint may be briefly outlined as follows:

1. Accurate foreign-body localization.
2. Careful débridement of all soiled and devitalized soft tissues and soiled bone.
3. Removal of all loose bone fragments and foreign bodies.
4. Irrigation of the joint with saline.
5. Filling of the joint with ether.
6. *Primary closure of the joint by suture, usually including the skin.* With considerable injury to knee or muscle, it is wiser to close the joint capsule, but leave the skin and muscle unsutured.

* Read before the Sharon (Conn.) Hospital Association, July 19, 1919.

7. *Early and frequently repeated active motion of the knee,* no splint being applied, save with massive bone injury. This mobilization is begun upon the second day, and is continued at two- or three-hour intervals. The patient is up about the ward, with crutch support, on the fourth day, and is encouraged to walk without any support by the tenth day.

The treatment of infected knee-joints was outlined by Willems in the following manner: Opening of the joint through sutured wounds or by lateral incision, no drains of any kind being introduced. Active mobilization was continued, as with the non-septic knees, the patient being awakened at two-hour intervals, night and day, and encouraged to move the joint. As soon as practicable the man was compelled to get up out of bed, and to use the leg in as normal a manner as possible.

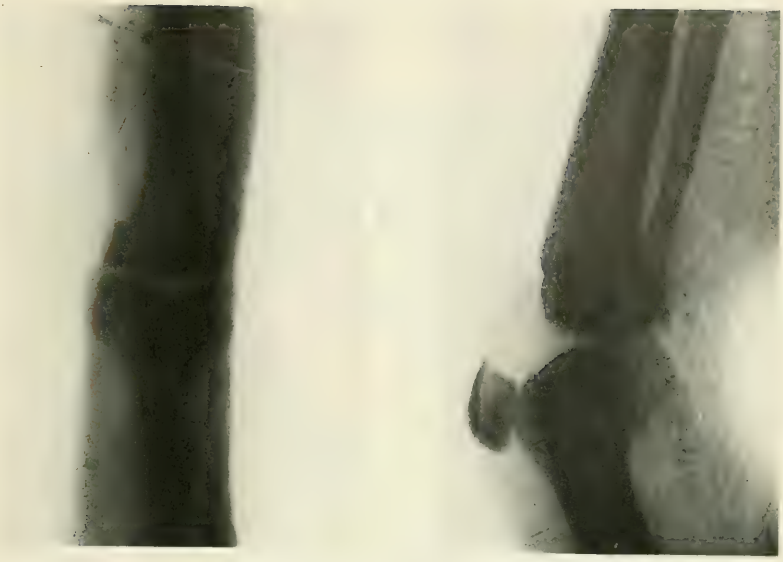
The advantages of this treatment of wounds of the knee-joint were a quicker recovery, a higher percentage of good functional results, and an active soldier back in the line in a few weeks. Many of the cases of septic joints obtained normal functionating knees. Surgeons generally were, however, inclined to be very dubious about such a radical departure. The technic seemed to be in such absolute variance from established surgical principles and practice that some at first concluded that the effort was a sort of fad, and paid little heed to the new doctrine. Later, when Willems showed in Paris a considerable number of his end results, the truth was evident at once, and the principle of treatment was accepted by most as sound and reasonable.

One may properly inquire what the general opinion has been and is:

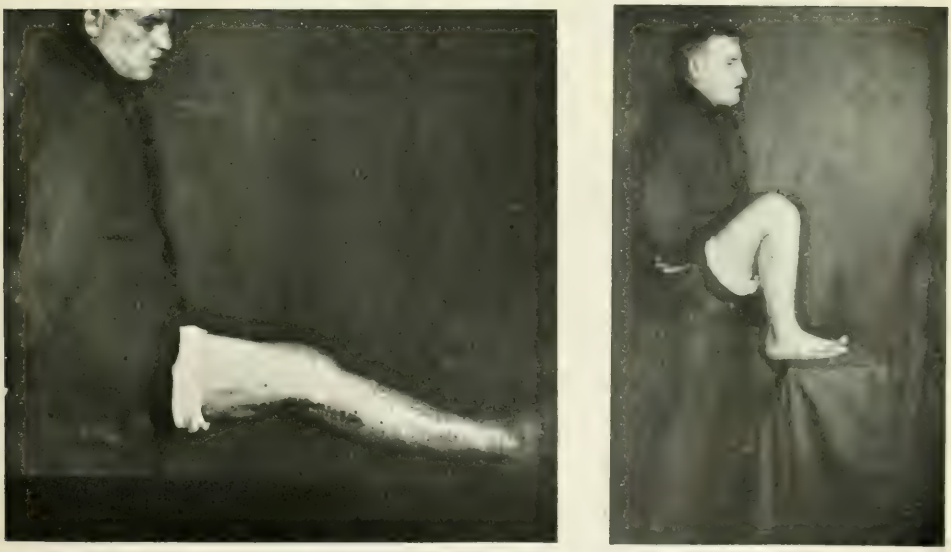
*A.* Abroad, among the surgeons of the A. E. F., at the time of the Armistice.

*B.* Here, at home, now.

*A.* In the latter part of November and December, 1918, in company with Major Mixter and Major Kerr, I was privileged to visit all of the evacuation hospitals and mobile units of the American Army, and later, every base hospital in France. The object of this visit was to collect data for a certain report to be made upon the end results in certain special types of cases. Among other classes of patients, results in wounds of the knee-joint were collected and opportunity was afforded to gather information from various surgeons who had operated both in the advanced and base areas. Rarely, one would meet a surgeon who was rather enthusiastic about the results of active mobilization of joint injuries, and he was usually a man who had had service in the advanced zone, and also some work in a base area. In general, however, we had a very definite impression that the surgeons, as a rule, were unenthusiastic and more or less hopeless about this new treatment of joint injuries. They usually stated that they had had few good results as to function of the joint, and that most of the cases had come down to the base sections with infected

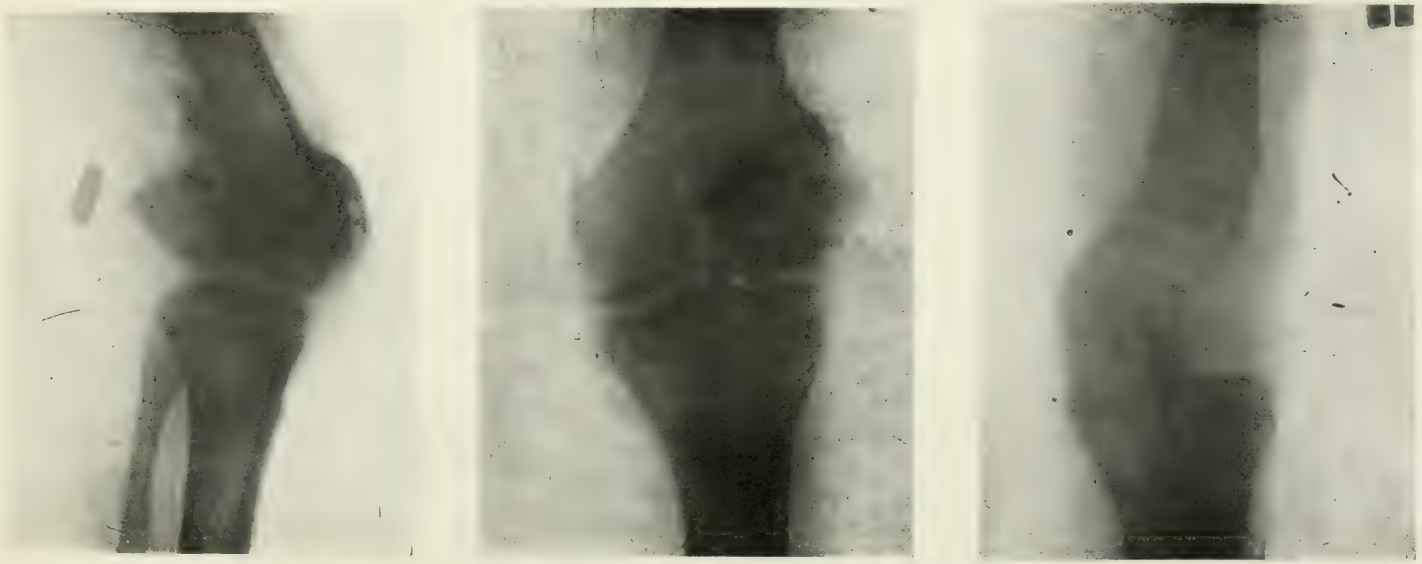


FIGS. 1 AND 2.—Penetrating bullet wound of right knee-joint.



FIGS. 3 AND 4.—A. Hoyois. Service of Dr. Delrez of La Panne. Penetrating bullet wound of right knee-joint. Open operation. Primary closure. Immediate mobilization. Picture taken three and a half weeks after operation. Joint function normal.

FIGS. 5 AND 6.—G. Neuteleers. Service of Dr. Delrez of La Panne. Penetrating shell wound of left knee-joint. Suppuration after operation. Six weeks post-operative. No pain. Large return of function. Normal use of joint although anterior opening into joint still persists.



FIGS. 7, 8 AND 9.—Penetrating shell wound of right knee-joint with marked splintering of patella and internal condyle. Patella and part of condyle removed. Suppurated.

FIG. 10.—Shell wound of right knee-joint; posterior view of case shown in Figs. 7, 8 and 9.

FIG. 11.—Shell wound of right knee-joint showing method of support and dressing case shown in Figs. 7, 8 and 9, four weeks after operation. Flexion of joint. Extension by pulleys. Later plastic operation on extensor tendon gave useful joint with brace.

joints, requiring free incision, and later either resection or more often amputation. Some of the men died of sepsis.

*B.* Here at home, many men are found who are even now totally ignorant of this new line of procedure, and many who have come from abroad are equally pessimistic about the results obtainable.

What, then, are the reasons for this variation in opinions concerning the soundness of the treatment, held on the one hand by Willems, Delrez, some French, British, and American surgeons, and on the other, by many American surgeons to-day.

*A. The Optimistic View.*—Those enthusiastic about knee-joint results have invariably seen cases from quiet sectors with fixed lines where the surgery developed has been carefully systematized, and ideal conditions have existed for surgical work. Cases were evacuated from the front line trenches into a well equipped and carefully organized hospital, and most patients were on the operating table within a few hours after injury. Skilled surgical treatment was always available and the efficient after care of every type of case lay in the hands of the man best qualified to handle it. I was very much impressed by the careful, painstaking work of Doctor Delrez at La Panne with the joint cases there. The entire morning was spent on rounds, and each patient with a joint injury was encouraged to move his joint under Doctor Delrez's personal supervision. The operative technic carried out on these cases was finished, a clean dissection being made with the smallest amount of traumatism possible. The work was never hurried, and when the operation upon the joint was finished, one had the conviction that a careful débridement of all soiled tissues had been accomplished.

In the considerable number of knee-joint injuries in Doctor Delrez's service, the results were really excellent. Even in the cases in which infection occurred, active mobilization of the joint was continued without ceasing. Upon morning rounds, the patients with infected knee-joints who had not been following out the principle of active mobilization could readily be picked out without even questioning the man, as the higher temperature and the man's complaint of pain testified at once that the joint had not been moved. In other words, the only efficient drainage of a septic knee-joint that is possible is the movement of the joint itself. Dressings applied should not be confining, that they may interfere as little as possible with joint movements. It is indeed a weird experience to see a man walking about a hospital ward with a considerable opening over the knee-joint, through which one may look directly into the joint cavity, and from which is exuding thin, purulent material, and yet see this man bend his knee and extend it to the normal ranges without any pain and walk about with perfect comfort.

*B. The Pessimistic View.*—In contrast with these ideal conditions on certain sectors of the front, the problems confronting the medical corps of the United States Army were most of the time difficult and very com-

plicated, due to the activity of the campaign and the evacuation necessities of the wounded. A further analysis of the reasons for some of the poor results in knee-joint surgery revealed the fact that the case had passed through several hands up to the time that it had reached the base area. Although the man in the advanced hospital may have started the treatment along perfectly proper lines, the active mobilization was frequently discontinued during a trip down in the train or in the hospital farther to the rear, and the whole early treatment was vitiated. It is almost impossible to get a knee-joint back on active mobilization if the man has been allowed to keep the knee immobile during a period of several days. In some instances, a surgeon in an advanced hospital may have done a careless débridement of the joint, and any type of treatment following such a procedure would necessarily be ineffective. In times of great push, evacuation was so difficult through roads packed and jammed with supplies, guns, ammunition, troops and ambulances, that wounded men could not reach their first hospital for operation in from fifteen to twenty or thirty hours. Under such conditions, the ultimate results of knee-joint injuries would necessarily be less favorable. The marked exception to the conditions present along the American front was the situation at American Evacuation Hospital No. 1, near Toul, serving most of the time a fairly quiet sector of the line. Picked surgical talent was assigned to carry on the clinical work here and the whole setting for ideal surgery was complete. Although no accurate figures are yet at hand telling the end results of any particular group of cases, I believe one can say without exaggeration that the surgical work done upon joints in this institution will compare favorably with that of the best surgery of the other armies, and that the end results in the joint cases treated here were excellent.

*Conclusions.*—American surgeons will, therefore, not attempt to carry over into civil practice the technic and type of treatment which we have outlined as present under conditions of push in the American Army abroad. The best surgical judgment will rather seek out some institution or institutions where a quiet line and a well-organized stable hospital, furnishing the best of surgery under ideal conditions, gives the nearest approach to civil practice. We may have absolute assurance that the same results may be obtained at home as these picked hospitals furnished, and we may confidently believe that the treatment proposed by Willems and practiced by himself, Delrez, and many others, is sound and here to stay, and represents one of the outstanding contributions which the war has brought to civil surgery.

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# TRAUMATIC FAT NECROSIS OF THE FEMALE BREAST AND ITS DIFFERENTIATION FROM CARCINOMA *

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THE object of this report is briefly to set forth the clinical, operative, and pathological findings of two cases of traumatic fat necrosis of the breast, recently encountered at the Memorial Hospital. Although much has been written concerning the differentiation between the benign lesions and mammary carcinomata, a careful search of surgical and pathological literature has failed to reveal any reference to this subject, for it has apparently hitherto been unrecognized.

We have the hope that the data presented and the discussion stimulated by the study of these two cases may result in a better understanding of the clinical and pathological aspects of this subject and lead to its more accurate diagnosis in the future.

Clinically the simulation to carcinoma is very startling, and we desire to place special emphasis upon this point. In one of the cases, a radical amputation of the breast, muscles and axillary contents was performed, the operator believing that the tumor was malignant. In the other patient only local removal of the mass was practised, at first, but gross examination of the cross-section, in the operating room, led one of the writers to a diagnosis of carcinoma, which was confirmed by another surgeon, but not concurred in by a third. The breast was removed, but the muscles were not sacrificed. A more careful analysis of the gross and microscopic appearances made the real character of the lesion apparent.

CASE I.—E. B. The woman was a white, native-born American, aged fifty-two years, and was a widow. She was admitted to the Memorial Hospital August 29, 1919.

*Chief Complaint.*—A growing mass of considerable size in the right breast.

*Family History.*—Negative for carcinoma.

*Past History.*—Previous illnesses: She was operated upon at the Memorial Hospital, six years previously, for an abscess of the right side of the neck. She had had several miscarriages. Her past history was otherwise negative.

* Read before the American Surgical Association, May 5, 1920.

*Breast History.*—She had had no lactations and there had never been any ailment with either breast.

*Present Illness.*—In May, 1919 (three months before her admission to the hospital), she received a definite trauma to the right breast. This occurred while she was sitting in a street car. A woman carrying a child fell heavily against the patient, delivering a severe blow with her elbow against the right breast. This incident was not followed by tenderness or pain. Three months later (three days before her admission to the hospital) the patient noticed a lump, about the size of a lime, at the site of the former injury, in the upper outer quadrant of the right breast. This mass has been unassociated with pain.

*Physical Examination.*—The patient was a well-developed, well-nourished white woman, weighing about 190 pounds. Her general physical examination was negative, with the exception of the lungs, which showed on percussion slightly increased dulness between the scapulæ, together with a few scattered sibilant râles. Röntgen-ray examination of the chest showed no evidence of tuberculosis or metastasis. The Wassermann was twice reported negative.

Breasts: The mammary glands were of large type. A tumor was present in the upper outer quadrant of the right breast, measuring about 5 by 4 cm. There was no retraction of the nipple, nor was there any discharge from it. The mass showed moderate fixation to the skin, with some slight surface dimpling. There was some attachment to deeper structures. No axillary or supraclavicular nodes were palpable. The left breast was normal.

*Provisional Diagnosis.*—Primary carcinoma of the right breast.

*Operation.*—On September 23, 1919, the right breast, muscles, and axillary contents were removed by Doctor Bolling.

*Pathological Examination. Gross Examination.*—Three centimetres above and outside of the nipple situated in the breast was a tumor mass 2 cm. in diameter, irregular, circumscribed, but not encapsulated. It merged along one border with the fat tissue and elsewhere with the breast tissue. The tumor was opaque, brownish yellow, as in a xanthoma, and there was irregular hyperæmia along the upper edge. The growth lacked definite cicatricial character and chalky streaks.

The whole breast was uniformly fibrosed and contained no cysts. The axillary nodes were slightly enlarged and apparently not cancerous.

*Microscopic Examination.*—Sections showed broad areas of fat necrosis, surrounded by a broad zone of new cellular connective tissue, in which large vessels showed active obliterating endarteritis. Along certain segments of necrotic areas there was granulation tissue containing several large giant-cells. A search for spirochæte in the tissues was negative.

The patient was discharged from the hospital October 1, 1919, eight days after operation, having had an uneventful convalescence.

*Subsequent Notes.*—The patient was readmitted on November 10, 1919, because of persistent hemorrhage from the vagina. Examination revealed a small bleeding-point on an otherwise normal cervix.

On either side of the vaginal vault were fungoid epithelial growths and half way down the posterior wall was another small tumor.

Sections taken from the vaginal growths were reported to be basal-celled carcinoma.

The patient was treated with radium by Doctor Bailey, and is still under his observation.

March 31, 1920, no evidence of disease in the vagina and cervix was apparent. The final outcome of the vaginal tumor will have to be subsequently reported.

Doctor Ewing has stated that the vaginal growth bears no relation of any sort to the traumatic fat necrosis of the breast, but these data are included as a part of the follow-up history of the case.

Case II.—R. R. The woman was a Roumanian, aged thirty-six years and was married. She was admitted to the Memorial Hospital January 15, 1920.

*Chief Complaint.*—A lump in the right breast, which was steadily increasing in size.

*Family History.*—Negative for carcinoma and tuberculosis.

*Past History.*—Occupation: housework. Habits: abstemious. Weight: her usual weight was 211 pounds, and this was approximately her weight at admission.

*Previous Illnesses.*—She had always been well, with the exception of two extra-uterine gestations, both of which necessitated operative procedure.

She had never had any miscarriages.

Her past history was otherwise negative.

*Breast History.*—There had been three lactations: the first one fifteen years ago, the last one four years later, the duration of each having been about a year.

The nipples had always protruded.

There had never been any unusual breast incident during her nursing period.

*Present Illness.*—June 22, 1919 (about seven months before her admission to the hospital), her last operation for ectopic pregnancy was performed. Pleurisy and pneumonia developed and she became dangerously ill. She was given a hypodermoclysis under the right breast, three quarts of saline being introduced. No unusual pain was associated with this administration. One month later (six months before admission) she first accidentally noticed a small lump, the size of a walnut, in the upper and inner part of the right breast at the site of the previous injection. This mass had caused no pain whatever, but had been steadily increasing in size.

*Physical Examination.*—The patient was a robust, middle-aged woman, of unusually large build. Her appearance indicated perfect health. The general physical examination was negative. The lungs were clear throughout and fluoroscopy of the chest was negative.

Breasts: Large and pendulous. The left breast was normal.

The right breast showed no retraction of the nipple, nor was there any elevation of it. About 3 cm. to the inner side of the right

nipple was a mass, 3 by 2 cm. in diameter, making it approximately the size of a small hen's egg. The tumor was roughly cylindrical, fairly sharply circumscribed, and had a distinct firm edge. The mass was hard in consistency. It lay just beneath the skin on the upper inner aspect of the breast, near its posterior surface. The tumor showed slight skin adherence, but was, however, movable in the breast and not attached to deeper structures. There was one small soft lymph-node in the right axilla.

*Provisional Diagnosis.*—The provisional diagnosis was carcinoma of the breast, although the circumscribed character of the mass suggested the possibility of a benign adenoma.

*Pre-operative Treatment.*—The patient received the usual pre-operative Röntgen-ray cycle for the chest, breast, axillary and supraclavicular regions, the cycle being completed on January 21st. Operation was performed nine days later.

*Operation.*—Under ether anæsthesia a local excision of the tumor was made through the anterior aspect of the breast, going well wide of the involved area. This local excision was done because the mass was so sharply defined that it seemed possible that malignancy might not be encountered. The tumor was immediately sectioned after its removal, and was found to consist of two sharply outlined solid areas, while between them lay a small cavity containing thick, oily fluid. As the knife passed through the solid tumor tissue one had the same impression of cutting a hard, granular substance that one experiences in sectioning a carcinoma. Although none of the minute yellow points so frequently seen in carcinoma could be distinguished, its extreme hardness made me feel fairly certain that the case was one of cancer of the breast. Another surgeon present concurred in this gross diagnosis. However, Doctor Stone did not believe the tumor was carcinomatous.

An amputation of the breast was then performed down to and including the fascia covering the pectoralis major muscle. The muscles themselves and the axilla were not disturbed. Further operative procedure was to depend upon the report of the pathologist.

*Post-operative Diagnosis (by the Operator).*—Carcinoma of the breast: Following the operation the operator was considerably concerned about the outcome of the case, having a fairly definite conviction that a more radical operation should have been performed. He was therefore very anxious to learn the result of the gross examination, anticipating criticism of the incompleteness of the operation. He was greatly surprised, however, to be told that the breast itself should not have been removed, that local excision of the tumor was all that had been indicated and that the lesion had no malignant features.

*Pathological Examination. Gross Examination.*—There was an indurated area, 2 by 1 by 4 cm., slightly cicatricial, not quite hard enough for carcinoma; well circumscribed, almost entirely encapsulated, apparently a fat lobule,

which suggested a tumor process. On cross-section the texture was opaque, xanthematous and light yellow in color, not translucent, without definite chalky or silvery points. Adjoining was a smaller fat lobule, with a few similar slightly opaque points. Adjoining also was a cyst, 1 cm. wide, containing creamy contents, having a smooth blood-stained wall.

*Gross Diagnosis.*—Chronic inflammation in fat tissue. The remainder of the breast was normal.

*Microscopic Examination.*—The structure of the lesion showed chronic productive inflammation in fat tissue. There were no evidences of carcinoma. The fat-cells were proliferating, replacing fat, and many small giant-cells were present. There was much diffuse new fibrous tissue, which accounted for the opacity. In places there were collections of lymphocytes and occasionally a few cysts. The large cyst was lined by large epithelial cells of the sweat-gland type. A few accompanying breast alveoli showed round-cell infiltration.

There was no unusual incident in the patient's convalescence.

*Incidence.*—At the Memorial Hospital the ratio of traumatic fat necrosis of the breast to mammary carcinoma is as 2 to 330, or 0.6 per cent.

*Pathology.*—In our study of the pathology presented in these two cases we are greatly indebted to Dr. James Ewing, pathologist at Memorial Hospital, and he has outlined the following points in the gross examination of traumatic fat necrosis of the breast.

*Gross Appearances.*—The differential diagnosis of the gross lesions in these two cases presented an interesting problem. A careful study of the details of the naked-eye appearance led to the conclusion that in neither case was the lesion carcinomatous.

In the case of E. B. the presence of a rather large area of opaque discolored fat tissue, nearly diffluent in the centre, was satisfactory evidence that the chief material was necrotic fat. This area along one side was sharply demarcated from normal fat tissue, as is infiltrating mammary cancer; but this zone failed to show the positive signs of carcinoma, such as cicatricial contraction, grayish lustre, and fatty and chalky points and streaks. Likewise the rather broad zone 2 to 3 cm. of cellular granulation tissue did not present the form, outline, or texture of carcinoma. Accordingly, a gross diagnosis against a neoplastic process was rendered.

In the case of R. R. the gross diagnosis was more exacting, but was accomplished by careful adherence to the criteria of gross anatomical diagnosis of mammary cancer. Here there was one separate area, 2 by 2 cm., of necrotic fat, which was readily recognized. A second area presented greater difficulties. This was an oval area of 2 by 1 cm., firm and cicatricial in appearance, with exanthematous texture and considerably resembling carcinoma. However, it was observed that this area was fairly well encapsulated; that in size and form it was exactly similar to the adjoining fat lobules; and that it did not present the smooth opaque texture of carcinoma nor the chalky points or streaks. On these data the diagnosis of chronic inflammation of fat tissue was given. Paraffin sec-

tions revealed a productive inflammatory process with multiplication of many cuboidal fat-cells lying in alveoli, which would have been difficult to distinguish from alveolar carcinoma in a frozen section.

*Microscopical Appearances.*—Areas of necrosis in fat tissues were to be seen with new connective-tissue cells, growing in and about these areas of necrosis. This growth of new tissue was very abundant, and with the giant-cells which one saw scattered throughout the tissue a luetic granuloma might superficially be suggested. Many of the giant-cells were markedly flattened, the syncytial tissue being closely applied along the borders of huge vacuoles, which corresponded to large tissue spaces containing diffluent fat. These giant-cells were, therefore, of the so-called foreign-body type. Certain portions of the sections show proliferation of the nuclei of fat-cells, these same cells showing also an opaque zone close to the periphery of the cell, probably representing certain changes in fat saponification.

The blood-vessels show an obliterating endarteritis which was apparently of recent origin and a perivascular infiltration with lymphocytes.

*Diagnosis.*—Trauma appears to be an essential and distinctive etiological factor in connection with fat necrosis of the breast. A history of the appearance of a mammary tumor with no preceding definite trauma would practically eliminate fat necrosis as a possible diagnosis. Although trauma is not infrequently encountered in the history of a mammary cancer, it is often indefinite and frequently absent. A recent exception to this rule was met in a young woman, aged twenty-six years, who received a terrific blow upon the breast by a hard-hit baseball. Six months later she developed, at the exact site of the injury, an encapsulated papillary cystadenocarcinoma of the breast. It is well known that this particular type of cancer is one of the less malignant varieties. In general, however, the surgeon should weigh carefully the evidence of distinct trauma to the breast and remember the possibility of a fat necrosis and the secondary chronic inflammatory changes attending it.

Clinically, traumatic fat necrosis of the breast very closely simulates mammary carcinoma and the differentiation may be very difficult. The symptoms of fat necrosis which strongly suggest malignancy may be enumerated as follows:

1. *Rapid Increase in Size.*—The mass of traumatized fat increases rapidly because of the proliferation of new connective tissue associated with the chronic inflammatory process. A period of several weeks or months may elapse from the time of the receipt of the injury to the appearance of the tumor; and from that time on the increase in size strongly suggests the possibility of malignancy.

2. *Skin Adhesions.*—Both the patients under report exhibited the same skin adherence which one sees in many cases of malignant disease of the breast. The tumor mass seemed held to the skin by several lines of adhesion and gave the impression of a solid tumor with superficial sur-

face closely adherent to overlying skin. This feature so often regarded as pathognomonic for malignancy was striking in both instances.

3. *Consistency.*—The consistency of the tumor in each instance was as hard as in the average case of malignancy. Although some of the benign fibro-adenomata are very hard, the two characteristics above mentioned are lacking in this type of growth. Upon the other hand, one must bear in mind the exceedingly soft, brain-like encapsulated carcinomata which are the most malignant of all types of mammary cancer. In general, hardness in a breast tumor suggests malignant possibilities, and traumatic fat necrosis with the reaction attending it produces a distinctly hard mass.

4. *Lack of Pain.*—No pain was experienced in the cases of fat necrosis. This gave an exact parallel to malignancy, because tumors of the latter type in their early stages exhibit an entire absence of pain. Only in the later, more advanced periods does a cancer of the breast cause pain.

5. *Adhesion to Deeper Structures.*—One of the patients showed definite fixity of the tumor to the underlying muscles. This symptom is almost invariably regarded as a sign of malignancy, and its presence, therefore, strongly influenced the surgeon in reaching a diagnosis of malignancy.

The points of differentiation from malignant disease may be outlined as follows:

1. The history of trauma is more exact and definite than with the average carcinoma.

2. The tumor in fat necrosis is fairly well circumscribed, while the mass in carcinoma is usually more diffuse.

3. The tumor is rather more movable in the breast than is usual with carcinoma.

4. Axillary nodes, if present, have not the hard consistency of those associated with cancer. This differential point would, of course, be of no value in a very early mammary cancer without metastasis in the nodes.

5. The characteristic gross appearances of fat necrosis upon cross-section of the tumor have already been outlined under the paragraph on pathology.

Discussion.—Several points worthy of discussion may briefly be referred to:

In connecting the appearance of a tumor with a history of trauma one should bear in mind the four medicolegal points usually required:

1. The history of trauma must be sufficiently definite and of a severity adequate to produce the tissue damage.

2. The site of the trauma and the location of the lesion must be identical.

3. A proper time relationship must exist from the receipt of the trauma to the appearance of the tissue changes.

4. Proof should be at hand that the tissue was normal before the receipt of the trauma.

All of these requirements, save the fourth, are met in the cases of fat necrosis, and it is obviously impossible to fulfill the fourth requirement.

When the wide distribution of subcutaneous fat is considered, one may well ask the question, Does fat necrosis from traumatism ever occur in the tissue? Our colleague, Doctor Farr, of the New York Hospital, has completed a paper, about to be published, in which several cases of traumatic fat necrosis in subcutaneous tissues are reported. Boxers and wrestlers must be subject to a tremendous number of traumatisms to the superficial fat. It seems probable that some defensive mechanism must exist to prevent the development of necrosis in fat tissue following trauma. In the cases in this report it seems fair to assume that some peculiar conditions may have been present, permitting the trauma to bring about the lesions described.

In the first case lues might be thought of as a possible etiological factor, on account of the miscarriages, the granulomatous appearance of the tissue and the obliteration of endarteritis. However, two Wassermanns in expert hands were negative, and a careful search for spirochætes failed to reveal any organism.

The second patient showed nothing in the tissues quite comparable to the extensive granulomatous changes found in the first patient, and here syphilis could be dismissed at once.

We feel, therefore, that a leutic element in these cases may be positively dismissed as having no bearing upon the pathology of this disease.

## CONCLUSIONS

1. Traumatic fat necrosis of the female breast is a definite clinical entity.
2. It must always be included with the benign lesions of the breast.
3. Clinically, it more closely resembles carcinoma of the breast than any other tumor, and must be differentiated from it.
4. A distinct history of trauma to the breast and a well-circumscribed, firm mass, showing rapid increase in size, unassociated with pain and without axillary nodes that are firm, suggest the possibility of fat necrosis.
5. Local removal of such a mass is justifiable if a proper gross diagnosis can be made in the operating room. Should the gross examination reveal carcinoma, complete amputation may then be performed.
6. The diagnosis of traumatic fat necrosis of the breast by gross examination is possible. The gross features of this lesion should, therefore, be clearly understood by every surgeon.
7. Further lines of research, along chemical as well as along morphological lines, may throw additional light upon the real nature of this process.

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# A CONSIDERATION OF 8589 CASES OF HERNIA TREATED BY RADICAL OPERATION FROM 1891 TO 1918, WITH SPECIAL REFERENCE TO METHODS OF OPERATING AND END-RESULTS

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In order to study the merits of the surgical treatment of hernia it is essential to consider a large number of cases which have been operated upon. We have therefore collected all of these cases operated upon at the Hospital for Ruptured and Crippled since 1890 and the cases operated upon outside of that institution by Drs. Coley and Hoguet. The total number of cases under consideration is 8589. Of these, 6090 were operated upon at the Hospital for Ruptured and Crippled by Drs. William T. Bull, William B. Coley, John B. Walker, William A. Downes, C. G. Burdick, D. H. M. Gillespie and J. P. Hoguet. Of the remainder 1904 were operated upon by Dr. Coley and Dr. Downes, and 595 by Dr. Hoguet in hospitals other than the Hospital for Ruptured and Crippled. By giving the details of this large number of cases we believe we can demonstrate the efficacy of certain operative methods of treatment in certain types of hernia, as in all these cases a certain very definite operative technic was closely followed by the operators mentioned above. As can be seen from the accompanying tables, all types of hernia are included in the series and the patients were operated on at all ages, so that in every way the series is very wide in its scope. Great efforts have been made

to keep in touch with patients after operation. A large number report back at certain regular intervals and postal card inquiries are addressed to all at yearly intervals. We therefore think that we have traced a large number of the recurrences that have occurred among our cases.

Lack of space will not permit any reference to the older methods of operation for the radical cure of inguinal hernia, which were largely abandoned with the advent and early adoption of Bassini's method in 1890 and the years immediately following.

Of the various methods brought out since 1890 the majority have been more or less modifications of the Bassini method, and the more they have departed from the underlying principles of Bassini's method the less satisfactory have been the results. The Halsted operation, originated almost simultaneously with, though independently of the Bassini method, resembling it in the main features—the transplantation of the cord and suture of the internal oblique muscles to Poupart's ligament—while a great improvement on the methods which preceded it, had certain disadvantages which did not attach to the Bassini method, and it soon gave place to the typical Bassini operation.

Among the other methods which came into vogue shortly after the Bassini method, and which proved so efficient that they are still regarded as methods of choice by many surgeons at the present time, may be mentioned the so-called Ferguson method (Chicago) and the Wyllys Andrews method. Both of these methods closely resemble Bassini's method in many respects, the Ferguson method being practically identical with the Bassini method, with the step of the transplantation of the cord omitted. In the Andrews method not only the transplantation step is omitted, but a special method of applying the overlapping principle originally outlined by Championnière is made use of in closing the canal.

All of these methods embody the main principles of the Bassini operation—namely, the long external incision parallel with Poupart's ligament over the center of the inguinal canal, with free splitting up of the aponeurosis of the external oblique. This

latter important step for the first time made it possible to expose clearly the internal ring and permit complete removal of the sac at or beyond its neck, thereby obliterating any funicular process of peritoneum which might favor the early recurrence of the hernia. The second important principle of Bassini's operation is also included in these modifications: The suturing of the internal oblique and sometimes the external, to Poupart's ligament. The transplantation step was believed to be an unnecessary part of the technic and of little value, and therefore omitted.

Good and even excellent results were obtained by many surgeons who adopted these modifications of Bassini's method.

We think it might be wise to give a brief description of the exact technic of the different operations as performed by us:

Inguinal Hernia Indirect. 1. An incision $2\frac{1}{2}$ to 3 inches long (or 3 to $3\frac{1}{2}$ inches in adults) is made parallel with Poupart's ligament and about $\frac{1}{2}$ inch above it, so that the lower end of the incision comes directly over the center of the external ring.

2. The aponeurosis is slit up a distance of $2\frac{1}{2}$ to 3 inches in the direction of the fibers; in doing this it is important that the director should be withdrawn and the aponeurosis cut very carefully, so as to avoid severing the ilio-inguinal nerve which is frequently sacrificed at this step.

3. The aponeurosis is dissected well back on the inner side toward the rectus muscle, giving a full exposure of the internal oblique muscle. On the outer side the aponeurosis is dissected until Poupart's ligament is exposed to the pubic bone.

4. The sac and cremaster muscle just over the canal and above the external ring are seized with a pair of thumb forceps and lifted up and the muscular fibers pushed aside by means of a pair of blunt-pointed curved scissors. The white tissues of the sac are thus quickly exposed and held by a pair of artery clamps in the left hand, and with the thumb and fingers of the right hand the cremaster muscle is quickly and easily dissected from the sac and cord.

5. The next step is to cut through the layer of infundibuliform fascia which surrounds the sac and cord in common, change the

clamp so that it grasps the exposed sac over its anterior margin, then with the thumb and forefinger of the right hand and a piece of gauze the cord is separated from the sac until the sac occupies a position above the forefinger of the left hand and the cord below. The sac is then cautiously opened to determine whether it is empty or contains omentum or bowel. If empty the anterior layer is then cut across the clamps, having first been attached to the upper end of the sac. The lower end of the sac can then be dissected out if it does not communicate with the tunica vaginalis; if it does, it is dissected down until the testis is reached, a purse-string suture is placed around the distal portion and the remainder removed. The proximal end of the sac is dissected upward until it widens out into the peritoneal cavity. At this point the sac is transfixed in the center with a double No. 1 plain catgut ligature and then tied off, so that there is no longer any funicular process of peritoneum. The cord is then held up by means of a strip of tape and clamp and the first row of buried sutures inserted as follows: The cord is held upright and the first suture of medium size kangaroo tendon (not too large) is introduced by means of a curved Hagedorn needle through the upper portion of the internal oblique muscle, coming across the inguinal canal so that it just touches the lower border of the cord when the latter is held vertically to the plane of the abdomen. The suture is passed outward, first picking up the cremaster muscle, and then the shelving edge of Poupart's ligament, and is finally tied.

The second suture is placed in exactly the same way, one-half inch below. The cremaster muscle is included in the first two sutures, thus affording additional strength to the deep layer. The benefit of thus utilizing the cremaster was first pointed out by Halsted, of Baltimore, many years ago. We believe it to be of considerable advantage.

Four sutures are usually required in adults. The fourth is perhaps the most important suture of the whole operation and is inserted in a special way, as follows: The external oblique is reflected inward and the ilio-inguinal nerve, which up to the present time is held on the inner side by a retractor, is now

released and allowed to drop back into its normal place. The reflected portion of the external oblique about one-half an inch above where it meets the conjoined tendon is picked up with a sharp Hagedorn needle. The needle then crosses over the nerve and picks up the outer portion of the conjoined tendon, crosses over beneath the cord and enters the lower part of Poupart's ligament, close to its attachment to the pubic spine. The tighter this suture is drawn the more room there is for the underlying nerve, which can never be compressed. This is essential, as a great deal of neuralgic pain, which often follows hernia operations, is undoubtedly due to this nerve having been caught in the sutures. When this suture is tied the lower portion of the inguinal canal is completely closed up to the pubic bone. This stitch is not a part of Bassini's original technic, but we believe it has distinct advantages and greatly lessens the number of recurrences.

Another modification in the Bassini method, which we have used at the Hospital for Ruptured and Crippled the past twenty-five years, is inserting one suture above the cord, passing it through similar structures to those below, making a new internal ring exactly sufficient for the cord to pass through without undue constriction, and, on the other hand, of sufficient size not to favor a recurrence. The aponeurosis is then closed from above downward by means of a continuous suture of fine kangaroo tendon, leaving just sufficient space at the lower end for a new external ring, through which the cord emerges.

The operation for inguinal hernia in the female is precisely the same as the operation we have just described, except that the round ligament is preserved and not transplanted.

Femoral Hernia. The method employed in practically all cases of femoral hernia has been the simple, so-called purse-string operation, consisting of (1) a very thorough removal of all the overlying fat which, in many cases of femoral hernia, completely surrounds the sac and makes it somewhat difficult to find the latter; (2) a very thorough freeing of the sac, putting it down so that it is possible to place the ligature well beyond the neck, and (3) the closure of the femoral canal by means of a purse-string

suture of kangaroo tendon. Using a curved Hagedorn needle the suture is placed as follows: The needle is first passed through the inner portion of Poupart's ligament or the roof of the canal, then downward, taking firm hold of the pectineal fascia and muscle, then outward through the fascia lata overlying the femoral vein, and finally upward, emerging through the roof of the canal about one-quarter inch distant from the point of entrance. When this suture is tied the floor and the roof of the canal come into easy apposition and the femoral opening is completely obliterated.

Umbilical Hernia. The Mayo method of overlapping was adopted at the Hospital for Ruptured and Crippled soon after it was published in 1898, and our results, we believe, show it to be superior to all other methods. The main principles of the operation are:

1. Transverse elliptical incision, including the umbilicus and, in very obese people, a considerable amount of redundant skin and underlying fat. This incision is carried down to the aponeurotic layer. Instead of incising the sac over the distal or most protuberant portion the opening is made near the neck of the sac or rather just outside of the aponeurotic ring from which the sac emerges. The reason for this is that in most cases of large umbilical hernia the sac contains great masses of irreducible omentum which are apt to be adherent to the distal portion of the sac, while the sac in the neighborhood of the aponeurotic ring is quite free from adhesions. Hence, if the incision is made at this point, there is no danger of injuring the contents of the sac.

2. If adherent omentum is present within the sac it is freed from these adhesions and removed, care always being taken to tie it off in very small sections with catgut ligature. The fascial ring of the sac is then enlarged on either side by a transverse incision; the overlying fat is carefully dissected from the anterior surface of the aponeurotic layer for a distance of 2 or 3 inches. The wound is then closed by a series of interrupted mattress sutures of medium-sized kangaroo tendon or with chromicized catgut, placed in the following manner: A Hagedorn needle,

kangaroo tendon of medium-sized sutures, pierces the upper flap 1 to 2 inches from its margin, passing through the entire thickness of the aponeurosis and peritoneum and then transversely through the whole thickness of the lower flap about $\frac{1}{4}$ inch from its margin; on returning it is passed through the under surface of the upper flap, the same distance from the margin, and $1\frac{1}{4}$ inches distant from the point of entrance. A sufficient number of sutures are passed in this way, to completely close the opening. It is advisable to insert all the sutures before tying any. When these sutures are tied the upper flap will overlap the lower $1\frac{1}{2}$ to 2 inches. The edge of the upper flap is then fastened, sutured with a continuous suture to the anterior surface of the underlying lower flap. This makes a firm double barrier to guard against recurrence.

Undescended Testis.—The method of operation in cases of undescended testis consists in free incision of the external oblique, as in the Bassini method of operation. The sac in all cases of undescended testis is extremely thin and the dissection must be made with great care. After the sac has been cut across, just above the testis, it is freed well up beyond the internal ring and tied off as high as possible. The lower end of the sac is sutured over the testis making a complete tunica vaginalis. The next step is to remove all the fascial bands which surround the veins. When this has been done it is usually possible to bring the testicle into the scrotum. In the few cases in which it is not possible the majority of the veins may be resected, leaving a little more than the vas and the spermatic vessels. This step was advocated by Dr. Bevan many years ago and has proved of very great value. In a very small number of cases gangrene of the testis is reported to have occurred, but we have not seen it in our experience. It should never be used as a routine measure, but only in the rare cases described. The cord is never transplanted but allowed to drop back in the lower angle of the wound; the internal oblique is sutured to Poupart's ligament, exactly as in inguinal hernia in the female. We do not suture the testis in the scrotum, as advocated by many surgeons.

In the majority of our cases the testis has remained in the

lower or middle scrotum, but in a considerable number it has retracted to the region of the external ring. In a few cases in which the testicle was of normal size at the time of operation it continued to develop in the normal manner after operation, but in the cases in which it was more or less atrophied at the time of operation it failed to increase in size after operation. In only two cases was the testis removed at the time of operation. It was so atrophied that it was almost impossible to recognize any testicular elements. Whether or not the undescended testis is of functional value is a problem which has not yet been settled. There are a few cases on record of parents with double undescended testis, that apparently have been able to produce children.

There have been no deaths in this series of 441 cases and no hernia has thus far been known to follow the operation.

The results in this group of cases might be used as an argument in favor of not transplanting the cord in the ordinary inguinal hernia in the male. However, it is hardly fair to draw this inference, for the reason that in the great majority of these cases the hernia was rather a potential one than an actual hernia, being merely an open process of peritoneum, communicating with the abdominal cavity and tunica vaginalis.

Direct Hernia. Far back in the early days of radical operation it was recognized that it was much more difficult to effect a permanent cure in direct inguinal hernia than in the oblique type. Special modifications of technic have been devised to meet these difficulties. Wölfler, in 1892, introduced a somewhat complicated technic in which the rectus was turned out of its sheath anteriorly and sutured to Poupart's ligament. Bloodgood, in 1898, published a modification of Wölfler's method and later advised opening the rectus sheath from behind. For many years we have held to the belief that the transplantation of the rectus muscle is almost essential to a permanent cure in direct inguinal hernia, particularly those of large size, and in our opinion the method described by Dr. William A. Downes[1] is the best thus

[1] Annals of Surgery, 1911, liii, 568.

far proposed for utilizing the rectus muscle. Unlike Slajmer we believe transplantation of the cord not only the method of choice in oblique inguinal hernia but of even greater importance in cases operated upon for direct inguinal hernia.

The method of operating on direct hernia as advocated by Dr. Downes is briefly as follows: (1) indirect and direct removal of the sac, with division of epigastric vessels; (2) the internal oblique and transversalis are held up by a small blunt retractor placed at the internal ring, and these muscles are followed, down and in, until they join the transversalis fascia at the outer margin of the rectus. The sheath of the rectus formed by these structures at this point is opened and the muscle is exposed down to its pubic attachment. By means of three sutures of kangaroo tendon the outer margin of the rectus muscle is sutured to Poupart's ligaments. The sutures are placed from below upward, and about one-half to three-quarters of an inch apart. In some cases four sutures are necessary. After this row of sutures has been completed the retractor is withdrawn and the usual Bassini operation performed from above downward, the internal oblique muscle being sutured to Poupart's ligament. The sutures in this case are just superficial to and between the first row. The external oblique is then closed in the usual way. There are three distinct layers instead of two as in the operation for oblique hernia. The cord is always transplanted and the cremaster if not too thin is included in the sutures uniting the rectus with Poupart's ligament. Up to the time of his report Doctor Downes had performed the operation in 50 cases of direct hernia; 10 had been traced for more than one year, having no relapse.

Further observation has, however, shown a certain number of relapses in the cases of Dr. Downes, and at present he is inclined to believe that as high a proportion as 10 per cent. of relapses will be found even after this method if the cases are traced to final results. In our own series Dr. Downes's technic has been employed only in a limited number of cases. Our aim has been to bring over to Poupart's ligament the anterior portion of the rectus muscle and rely upon the special stitch which we have already

described for closing the lower portion of the canal, which includes the reflected portion of the external oblique. This avoids the extra layer of suture to Poupart's ligament in Downes's technic. In many cases Poupart's ligament is so poorly developed and easily torn that the insertion of two layers may weaken the structure upon which we most rely for our repair of the canal.

Within the last twelve months one of the writers (Hoguet) has discarded this method of operating on direct herniæ and is trying out a new one which differs in several essential points. The indirect sac which, although very small in some cases, practically always exists and is first separated from the cord and opened. The deep epigastric vessels are not divided, but by traction outward on the indirect sac, practically all the peritoneum of the direct sac can be pulled externally to the deep epigastric vessels. By this method of treatment the danger of opening into the bladder when the direct sac is opened is obviated. Instead of suturing the rectus down to Poupart's ligament the deep sutures are introduced in the manner described for the innermost suture in the Bassini operation—that is, that instead of grasping only the conjoined tendon this structure, together with the reflected portion of the aponeurosis of the external oblique, is included within the deep sutures, the cord, of course, being transplanted. Over this the cut edges of the aponeurosis are sutured, anterior to the cord. None of the cases operated on by this method have recurred up to the present.

In spite of the most careful technic the porportion of recurrences in direct hernia will always be considerably greater than in the oblique variety. One of the chief reasons for this lies in the fact that most cases of direct hernia occur in adult males with poorly developed abdominal walls, and especially poorly developed internal oblique muscles. If the final results of the patients who have been operated upon for direct hernia are carefully followed up for at least a period of two years after operation we believe that fully 10 to 15 per cent. will show a distinct recurrence.

*Suture Material.* There is one very important point of technic which has an equal bearing upon all methods of operation for the

radical cure of hernia, and that is the material used in the buried sutures. Upon this factor often depends the success or failure of the operation. At the Hospital for Ruptured and Crippled we have had an unusul opportunity for observing the end-results of all methods of operation, and as early as 1890 to 1895 we began to see the increasing number of cases in which the disadvantages of using the non-absorbable sutures became very apparent. Since that time in the annual review of Hernia for *Progressive Medicine*, Coley has repeatedly called attention to these disadvantages and strongly urged against the further employment of non-absorbable sutures and buried sutures. In the early days, or twenty-five years ago, there was some excuse for their use because of the difficulties attending perfect sterilization of absorbable sutures. However, since those days it has been possible to obtain entirely reliable sterilized kangaroo tendon or catgut and there has been no further legitimate reason for the use of non-absorbable sutures in hernia. The suture that lasts more than three weeks is a disadvantage rather than an advantage, inasmuch as if there be any tension at the end of this period the suture will cut through until the tension ceases to exist, when the tendon will remain either as a harmless foreign body or, as is the rule in a not inconsiderable number of cases, will give rise to chronic irritation ending in an open sinus which persists until the foreign body has been removed. That these objections are not merely theoretical has been proved by a long series of observations. One of the most noteworthy cases illustrating this point was observed at the Hospital for Ruptured and Crippled in 1890, in which a silkworm suture had been used in a Bassini operation for inguinal hernia in an adult male six months before, and the wound had healed by primary union. At the end of this time a sinus formed and a suture was removed and the wound healed. He remained well for about two years when another sinus appeared; another suture was removed, and the patient remained well until three years and eight months later when a third sinus formed at which time the last of the sutures was removed. In addition to the discomfort attending these various periods of sinus formation the long-

continued suppuration with the consequent scar tissue, served to produce a relapse of the hernia.

In spite of the fact that such results have been frequently published and are generally known, silkworm sutures are still used in operations for the radical cure of hernia by some of the most distinguished surgeons here and abroad. Only a year ago a patient was sent to me for a sinus in the right groin and another one in the left upper scrotum, with the history that about a year before he was operated upon for a hernia and varicocele at one of the most prominent English clinics. The patient was told that in five weeks he would be ready for military service. At the end of five weeks a sinus appeared and remained open for about six months, when he was told he would never be able to go into the army, so he came to America. The induration in the left scrotum with sinus formation so closely resembled tuberculosis that this diagnosis was made in one of the out-patient departments in New York. It was not difficult to make a diagnosis, that buried or non-absorbable sutures were responsible for his condition. The sutures were removed and the sinuses promptly healed, but not until the young man had been made more or less of an invalid for nearly a year and until he had lost all opportunity of entering the army. The matter is so important that we have felt justified in again referring to it at such length.

From December, 1890, to January, 1918, 6090 operations for the different varieties of hernia have been performed at the Hospital for Ruptured and Crippled. The great majority of these operations were performed by a small group of surgeons—Drs. Bull, Coley, Walker, Downes and Hoguet—a small number by the assistant surgeons or house surgeons under our direct supervision.

| Varieties. | Cases. | Recurrences. | Per cent. |
|---|---|---|---|
| Inguinal hernia in males (oblique) | 4420 | 25 | 0.57 |
| females (children) | 690 | 1 | 0.15 |
| adults | 369 | 13 | 3.5 |
| Direct hernia | 33 | | |
| in adults (female) | 13 | 1 | 7.7 |
| Femoral hernia in children | 69 | | |
| adults | 182 | 8 | 4.4 |

(Four of these recurrences were in cases in which the operation was done for recurrent hernia, the primary operation having been done by other surgeons. They should therefore not really be included.)

| Varieties. | Cases. | Recurrences. | Per cent. |
|---|---|---|---|
| Umbilical hernia in children | 58 | | |
| adults | 104 | 3 | 2.8 |
| Ventral hernia in children | 24 | | |
| adults | 81 | 12 | 14.8 |

(Most of these were large ventral herniæ in stout women, following old laparotomies.)

| Varieties. | Cases. | Recurrences. | Per cent. |
|---|---|---|---|
| Epigastric hernia | 18 | 1 | 5.5 |
| Lumbar hernia | 1 | | |

In 334 cases the operation was for undescended or maldescended testis. In practically all cases, with 3 or 4 exceptions, there was a hernia, either actual or potential, that is, an open funicular sac communicating with the tunica vaginalis.

It is noteworthy that not a single relapse has been observed in these 334 cases of operation for undescended testis.

*Methods of Operation.* The typical Bassini operation, or the Bassini with slight modifications which have been described was performed in inguinal hernia.

| Inguinal hernia. | Cases. | Recurrences. | Per cent. |
|---|---|---|---|
| Bassini | 3725 | 14 | 0.38 |
| Cord not transplanted | 792 | 11 | 1.3 |
| Direct inguinal hernia (Bassini) | 24 | | |

It should be stated that these cases of direct hernia all occurred in adult females and in children under the age of fourteen years.

| Femoral hernia. | Cases. | Recurrences. | Per cent. |
|---|---|---|---|
| Transplanting rectus | 8 | | |
| Femoral hernia in children | 69 | | |
| adults | 182 | 8 | 3.1 |

It should be noted that four of the recurrences were in operations for recurrence.

The purse-string suture with kangaroo tendon was used in nearly all the cases after a very high ligation of the sac and the removal of all the overlying fat.

| Umbilical hernia. | Cases. | Recurrences. | Per cent. |
|---|---|---|---|
| Umbilical hernia, vertical overlapping . . | 34 | 2 | 5.8 |
| transverse or overlapping | 77 | 1 | 1.8 |

A study of the time of the recurrences, *i. e.*, the interval between operation and the time that the recurrent hernia was noted, is of very great interest and importance. In 4453 cases of inguinal hernia in the male, 25 recurrences were observed, and of these 13 occurred within six months to one year after operation; three within one to two years. The other cases occurred at longer periods after operation: one, after three and one-half years, 2 after seven years, 2 after three years, 1 after four years, 1 after fourteen years and 1 after twenty years.

*Mortality.* The mortality has changed very little since the earlier statistics. From December, 1890, to January, 1900, a period of ten years, 2732 cases were operated upon, at the Hospital for Ruptured and Crippled, with six deaths, or 0.22 per cent. From January, 1901, to January, 1918, 3358 were operated upon with 6 deaths, or 0.18 per cent. The later deaths occurred, for the most part, in cases of large irreducible strangulated umbilical hernia.

In regard to the end-results of the first period we find 15 recurrences in 2029 cases of inguinal hernia in the male, or 0.73 per cent. in the cases operated upon by the Bassini method and 42.8 per cent. in the small group of cases operated upon by Czerny's method.

In the second period, from 1900 to 1918, covering 220 cases, there were only ten relapses, or 0.45 per cent.

CASES OF INGUINAL HERNIA OBSERVED AT THE HOSPITAL FOR RUPTURED AND CRIPPLED

| | Under 1 yr. | 1–4 | 5–9 | 10–14 | 15–19 | 20–29 | 30–39 | 40–49 | 50–49 | 60– |
|---|---|---|---|---|---|---|---|---|---|---|
| Male . . . . | 4 | 790 | 1929 | 833 | 34 | 18 | 28 | 7 | 7 | 3 |
| Female . . . | .. | 86 | 322 | 150 | 60 | 84 | 86 | 47 | 18 | 18 |

In this series so far as it has been possible to trace, 1667 cases have remained well from one to four years; 586 cases have remained well from five to nine years, 193 cases have remained well from ten to fourteen years, 46 cases have remained well from fifteen to nineteen years, and 14 cases have remained well from twenty to twenty-six years.

Of 216 cases of femoral hernia, 169 have occurred in adults and 47 in children under the age of fourteen years; 99 cases have been traced in which the patients have remained well from one to twenty-four years after the operation and in the entire series 14 recurrences are known to have taken place.

Of 166 cases of umbilical hernia, 116 occurred in adults and 48 in children; of the latter, 21 occurred in males and 27 in females. In 66 cases the patients are known to have been in good condition from one to eleven years after the operation and in 25 cases for more than three years; 9 recurrences have taken place and 5 deaths—among the deaths was 1 case, a female, aged forty-four years, in whom an extensive operation for carcinoma of the ovary was performed in addition to the hernia operation, and the patient died four days later.

Of 103 cases of ventral hernia, 86 occurred in adults and 17 in children. In this series 41 have remained well from one to fifteen years, the remainder not having been traced. There were 11 recurrences.

Of 15 cases of epigastric hernia, 12 have occurred in children under the age of fourteen years and the remainder in adults; 6 cases are known to have been well from one to seven years after the operation and in 2 cases a recurrence took place.

Direct Inguinal. There have been observed at the Hospital for Ruptured and Crippled 54 cases of direct hernia, including 4 doubles, making a total of 58 cases of direct hernia. Of these, 37 cases occurred in adults (21 in females and 16 in males) and the remainder in children under the age of fourteen years. As regards the sex in the latter, all occurred in males with one exception. These figures, however, do not represent the actual relative proportion occurring in the two sexes. It is only during the last year that adult males have been admitted to the Hospital for Ruptured and Crippled. Direct hernia in the female is extremely rare and the relative proportion is more accurately shown in our statistics elsewhere. The final results in this list of 58 cases is of interest. In only 1 case is a recurrence known to have taken place. This case was complicated with a separate interstitial sac coming out of the internal oblique external to the internal ring and not connected with the round ligament; a recurrence took place seven months after the operation. Of the cases that have been traced, 18 have remained well from one to eight years.

The final results in the cases of undescended testis will be given in detail in a separate paper. A brief summary of the cases observed at the Hospital for Ruptured and Crippled is as follows:

Of 314 cases of undescended testis only 10 occurred in adults over the age of fourteen years. So far as can be traced 123 cases have remained well from one to twenty-one years after the operation, 64 cases over three years and 14 cases over ten years. It is interesting to note the position of the testis in these latter 14 cases. In 1 case well twenty-one years the testis was atrophied; in another well thirteen years after, the testis was not felt; in another well fourteen years the testis was outside of the external ring and the size of a hickory-nut; in another well eleven years the testis was not felt; in a second well eleven years the testis had disappeared; in 1 case well twelve years the testis was normal in size and position; in another case well twelve years the testis was small and at the spine; in another case well twelve years the

testis was in the channel; in 1 case well eleven years the testis was atrophied and lying on the external oblique just above the external ring and so on.

This large group of cases (405), including those observed by the writers at the Memorial Hospital, should throw some light upon the important question of whether the trauma connected with bringing the testis into the scrotum by operation favors the development of malignant disease. So far as we have been able to determine, in no single case in our series has the patient afterward developed a sarcoma of the testis. One of the authors (Coley), however, has observed a case of sarcoma in an undescended testis shortly after an operation had been performed for bringing it into the scrotum. The patient was operated upon in another city and it is impossible to state positively that the disease had not been fully developed before the operation, although in all probability in this case the trauma connected with the operation was an exciting factor.

Strangulated Hernia. Of the 31 cases of strangulated hernia observed at the Hospital for Ruptured and Crippled it is interesting to note that the majority occurred in children under the age of two years. The youngest case was a child, aged thirteen days, with a loop of small intestine fourteen hours strangulated. A Bassini operation was performed and the patient was well when last traced, many years later; 7 of these cases were under one year of age and 10 under two years. It is especially worthy of note that the only death in this series occurred in a woman, aged fifty-one years, with a very large strangulated umbilical hernia. The only recurrence which took place was in a woman, aged thirty-five years, with a very large strangulated umbilical hernia which was complicated by a seven months' pregnancy. A hernia operation was performed and was followed by severe suppuration of the wound, which together with the unusual strain of childbirth coming on two months later favored a recurrence of the hernia, which took place eight months after the operation; 13 of these cases traced were found to be free from recurrence from one to twelve years after operation.

Contents of the Hernial Sac. The cecum alone and with the appendix was found in 27 cases; in 1 case there was a slight relapse one year after the operation; of the remainder, so far as were traced, 12 remained well from one to twenty-one years after the operation. The appendix was found in the hernial sac in 39 cases. In all but 3 of these, the age of the patient was under fourteen years. In 8 of the earlier cases the appendix was not removed, but in the remaining 31 cases the appendix was removed at the time of operation. The ovary and tube were found in 9 cases; the tube alone in 4 cases and the ovary alone in 4 cases. One case of special interest is that of a woman, aged thirty years, with a double strangulated hernia in which a strangulated Fallopian tube was found in the right femoral sac; the patient was well and free from recurrence when last traced, eight years after the operation.

In 17 cases the bladder was found in the sac; 10 of these cases occurred in children under the age of fourteen years and 7 in adults between the ages of twenty-five to sixty-five years. In every case with one exception the bladder was recognized before it had been opened. This particular case occurred in a woman, aged thirty-seven years, with a left femoral hernia; the patient made a good recovery without complications.

Seven cases of tuberculosis of the hernial sac were found, in all of which the diagnosis was confirmed by pathological examination. One of these cases died of tubercular peritonitis some time after; one was well four years later and the remaining cases were not traced.

The results at the Hospital for Ruptured and Crippled have been often criticized as not furnishing a true criterion of the value of the radical operation for hernia, because so large a proportion of the cases have been in children under the age of fourteen. It is assumed without debate that it is much easier to effect a cure of hernia in children than in adults. Although our statistics at the Hospital for Ruptured and Crippled prior to 1890, when the older methods of Czerny and Socin were employed, show practically the same proportion of recurrences

in children as in adults, yet we believe that children and young adults are more favorable subjects for operation than older people. In order to throw further light on this question, we have included 2499 cases of adults operated upon by Drs. Coley and Hoguet outside of the Hospital for Ruptured and Crippled, and in Dr. Coley's service at the Memorial Hospital by Dr. William A. Downes.

Of these 2499 cases; 1383 were operated upon by Coley and Downes, 595 were operated upon by Hoguet, and 521 were operated upon by Coley at other hospitals:

| | Coley and Downes. | Hoguet. | Coley. | Total. |
|---|---|---|---|---|
| Inguinal in male, oblique | 1057 | 465 | 333 | 1855 |
| Inguinal in female, oblique | 59 | 12 | 111 | 182 |
| Inguinal in male, direct | 153 | 75 | 24 | 252 |
| Inguinal in female, direct | 2 | 3 | .. | 5 |
| Femoral | 65 | 15 | 21 | 101 |
| Umbilical | 23 | 11 | 31 | 65 |
| Ventral | 19 | 11 | 1 | 32 |
| Epigastric | 5 | 2 | .. | 7 |
| | 1383 | 595 | 521 | 2499 |

| Age as far as stated. | Cases. |
|---|---|
| Below 5 years | 54 |
| 5 to 10 " | 31 |
| 10 to 20 " | 394 |
| 20 to 30 " | 889 |
| 30 to 40 " | 549 |
| 40 to 50 " | 358 |
| 50 to 60 " | 170 |
| 60 and over | 54 |
| Total | 2499 |

Among the local sequelæ following radical operations for hernia are hydrocele and orchitis; among the general sequelæ: bronchitis, pneumonia, phlebitis and intra-abdominal swelling due to inflammation of the omental stump and embolism.

We believe that the local sequelæ are in direct proportion to the experience of the operator. If great care is exercised in dissecting the sac from the cord, with a minimum of trauma, the larger

vessels tied before cutting and the small bleeding-points controlled by ligature, hydrocele, orchitis or local swelling will very rarely be observed. We always support the testis by a little shelf or platform made of adhesive plaster placed across the upper portion of the thigh. Following operations for hernia we have observed 6 cases of pneumonia undoubtedly due to the anesthetic.

Excluding the recurrences which followed operations for strangulated and umbilical hernia we find in our series of 2499 cases 30, or a little over 1 per cent. of relapses. It has been impossible to trace the end-results in the adult cases as carefully as in the cases of children, and undoubtedly there have been a considerable number of recurrences in the former of which we have no knowledge. Allowing for these cases, however, the end-results in adults have been nearly as satisfactory as those in children.

The frequency with which thrombosis and embolism are the cause of death in abdominal operations, is brought out by E. H. Beckman[1] and L. B. Wilson,[2] both of the Mayo Clinic. Wilson states that during the period from 1899 to 1911 inclusive, 63,575 major operations were performed with 47 cases of fatal postoperative embolism, these fatalities representing 5 per cent. of the total number of deaths from all causes.

It is somewhat remarkable that thus far there have been no deaths from embolism in our series of 6090 operations performed at the Hospital for Ruptured and Crippled.

In 1383 cases operated upon at the Memorial Hospital by Drs. Coley and Downes there were 3 deaths. In the first case, a male, aged thirty-five years, operated upon by Dr. Coley, a large mass of omentum was replaced with some difficulty and probably considerable trauma. The patient died on the fifth day, with gradually increasing distention and signs of peritonitis. The second case operated upon by Dr. Downes died of infection and peritonitis. In a third case, operated upon by Dr. Coley at the Memorial Hospital—a very large irreducible umbilical hernia in a stout woman—death occurred. It was found almost impossible

[1] Annals of Surgery, May, 1913.
[2] Ibid., December, 1912.

to reduce the contents of the sac into the abdomen, and when reduced, respiration became difficult. The patient died two days later of heart failure; there was no evidence of sepsis. Another death occurred in a case operated upon at the Post-Graduate Hospital by Coley in 1895 in a strangulated femoral hernia with resection of the bowel.

Dr. Hoguet's series shows 6 deaths—2 males; 1 a strangulated indirect hernia, with general peritonitis, present at the time of operation and 1 a simple indirect acute, with atrophy of the liver; and 4 females: 1 a strangulated femoral, no resection, shock; 1 a strangulated femoral after gut resection; 1 a direct inguinal, acute nephritis, and 1 a ventral, with pulmonary embolism.

*The Methods of Operation Best Calculated to Meet the Needs of the Army and Navy.* The question of how to deal with the drafted or enlisted men with hernia has occupied no little attention of the Surgeon-General's office since the beginning of the war, and the problem has not yet been satisfactorily settled. The plan first adopted was to accept all men with hernia except the very large or irreducible cases, induct them into the service and then send them to the various cantonment hospitals, there to be operated upon by the surgeons in charge. This plan has not worked out with entire satisfaction for reasons that are apparent. We are beginning to study the question in the light of the experience gained by other nations which have been in the war longer than ourselves.

Canada began by adopting a plan very similar to our own, but we learn from Colonel Primrose and others that they were soon forced to abandon it because so many of the men broke down either from actual recurrence of the hernia or from real or imaginary troubles connected with the operation. These men became unfit for active duty. At present, in Canada, men with hernia are no longer accepted for active military duty even if operated upon successfully.

The British Army has attempted to solve the problem in a still different way. A special hernia department has been created and Lieutenant-Colonel Hull has been placed at the head. To

shorten the time of convalescence, he had devised a very simple method of radical cure which has been published in full in the *British Medical Journal*, October 27, 1917. It consists, in brief, of a short incision over the external ring; the aponeurosis is not cut; the sac is ligated as high up as possible and the external ring closed with two or three sutures. The operation is performed under cocain or local anesthesia and the patient is confined to the hospital for a brief period of about a week or ten days. The operation differs little from the old Czerny method, which we know from experience was followed by a large percentage of recurrences, 25 to 40 per cent. the first year. Lieutenant Hull believes that a large number of cases will be cured by this method and that those that do relapse can then be operated upon by Bassini's method.

We strongly disapprove of the adoption of such a plan in our own army. With the great shortage of men that exists in Britain it may be the best method for the British Army, although we doubt it.

Between the British plan of the very simple—and to our mind less efficient—method of operation and the Canadian method of rejecting all cases with hernia for military duty is there not some middle ground upon which we can formulate a plan which will more satisfactorily meet the exigencies of the case, at least for our own army? We believe there is and the plan we would propose is as follows:

Accept all enlisted men with hernia, with the following exceptions:

1. Large scrotal hernia (reducible or irreducible).
2. Direct hernia.

Send these men not to the cantonment hospitals, but to certain selected civil hospitals, so far as possible in the vicinity of their homes. Then have them operated upon by men who have had extensive experience in the operative treatment of hernia, allowing a considerable period for convalescence, at least three or four months, before sending them to the camps for active duty and six months before sending them to foreign service. It would

probably be longer than that before they would be sufficiently trained to go.

The statistics which we have just reported lead us to believe that it is possible to cure 95 to 97 per cent. of the cases of small reducible hernia in young adults from twenty-one to thirty-one years of age and fit them for the most severe strains of military life. More than ten years ago we adopted the rule on the New York Central Railroad to accept no employees with hernia until the hernia had been operated upon. Since that time a very large number of cases that were operated upon have been performing the arduous duties connected with railroad life, and thus far the number of recurrences observed has been extremely small, hardly worthy of mention. If these results can be obtained in the drafted men with hernia it would seem wise to utilize this very large number of splendid young men for active military duty instead of placing them in the deferred class.

The authors wish to express their thanks and appreciation to Dr. D. H. M. Gillespie for his very valuable aid in collecting the statistics for this paper.

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# OPERATIVE TREATMENT OF UNDESCENDED OR MAL-DESCENDED TESTIS WITH ESPECIAL REFERENCE TO END-RESULTS

## A Report of 415 Cases[1]

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IN the Out-patient Department of the Hospital for Ruptured and Crippled, from 1890 to 1918, there have been observed 80,736 cases of inguinal hernia in the male, of which 1,357 or 1.68 per cent were associated with undescended or mal-descended testis. From 1890 to 1918, 4,453 cases of inguinal hernia in the male have been operated upon, of which number 334 or 7.5 per cent were associated with undescended testis.

Of 1,040 cases of hernia in adults operated upon at the Memorial Hospital by Dr. William A. Downes and the writer, 49 or 4.71 per cent were associated with undescended testis.

In a paper read before the New York Surgical Society on April 22, 1908, I reported 126 cases of undescended testis which I personally operated upon, and which had been traced as far as possible to end-results.

While a number of articles have been written upon the subject since that date, there is still more or less doubt in the mind of the medical profession as to the indications for

[1] Read before the Southern Surgical Association, Baltimore, December 17-19, 1918.

surgical treatment and still a wide difference of opinion as to the best method of operation. Even at the present time, no large statistics exist in which the end-results of operative treatment have been given, and the present paper has been written chiefly with the hope that some further light may be thrown upon the question as to the condition of patients with undescended testis many years after operation.

In my earlier paper I dwelt with considerable detail upon the various theories as to the causative factors connected with the development of the undescended or mal-descended testis, and described the various types of undescended or mal-descended testis usually observed.

As regards the etiology of the condition, the theory that a mechanical obstruction of some sort due to inflammation, adhesions formed during fœtal life is the principal cause, has been strongly advocated by Buedinger and has found many adherents. Buedinger operated upon 24 cases of undescended testis of the inguinal variety, and states that he found mechanical obstruction of some sort in 15 of these 24 cases.

As I stated in my former paper, Odiorne and Simmons, of Boston, have made an important contribution to our knowledge of the pathology of the undescended testis in their paper published in the *Annals of Surgery*, December, 1904. They found a marked tendency to thickening of the tunica albuginea in nearly all of the specimens examined and an increased amount of interlobular connective tissue.

More recently, Uffreduzzi,[1] of Carle's Clinic in Turin, has made perhaps the most

[1] Arch. f. klin. Chir., c, No. 4, and ci, No. 1.

exhaustive study of the pathology of the retained testicle that has yet been published.

His observations upon the etiology of the undescended testis are of special interest. He states that the explanations offered by many of the earlier writers are exceedingly naive, in that these writers frequently confound the cause of the anomaly with its result. Kocher explained the incomplete descent of the testis as well as the atrophy of the gland by an inflammatory process during intrauterine life, but was unable to support his hypothesis by objective findings. The theory that the non-descent of the testis is dependent upon mechanical obstruction due to peritoneal adhesions occurring during fœtal life, was originally advanced by Cloquet and Wrisberg, and later strongly advocated by Buedinger and supported, he believed, by numerous necroscopic and operative findings. Buedinger goes so far as to state that in his opinion mechanical obstruction caused by such adhesions accounts for retention of the testicle in 96 to 97 per cent of the cases and that the instances in which a congenital origin of retention is apparent, will amount to not more than 2 to 3 per cent.

Uffreduzzi disagrees entirely with Buedinger's conclusion, and in regard to the great frequency of such cicatrices, he states that no other investigator has found them in any such proportion as Buedinger. Lanz stated that he found no such cicatrices in any of his 51 cases, nor did Uffreduzzi himself observe a single such case.

My own observations based upon our experience at the Hospital for Ruptured and Crippled, and other hospitals, are in accord with Uffreduzzi. I have found no evidence of old adhesions. Uffreduzzi lays far more stress

upon the element of heredity as a cause of ectopia, a theory first advanced in the classical paper of Godard's. The latter states that the descent of the testicle as it takes place in man is nothing but an example of the phylogenetic migration as it gradually takes place in zoological evolution. Hence, some authors consider retention of the testicle a simple continuation of a condition that is normal in certain animals, and that a retained testicle must be looked upon as a sign of arrested development.

I have personally operated upon a boy of thirteen years with double abdominal ectopia, who has a younger brother of 12, also with abdominal ectopia.

Uffreduzzi states that in the great majority of cases of ectopic testicle there are other signs of degeneration. In 24 cases examined by himself, he invariably found a greater or less number of distinct anomalies, physical as well as mental. In one case bilateral cryptorchism was associated with true hermaphroditism. This extremely rare form of hermaphroditism, of which only two other cases are recorded in the literature, represents one of the most serious forms of degeneracy known.

On basis of his investigations, Uffreduzzi concludes that retention of the testicle is hardly ever an isolated fact, but merely a local expression of infantilism, i.e., of a serious retardation in the development of the entire individual, which may be more or less pronounced and is nearly always accompanied by other bodily or mental abnormalities.

Uffreduzzi has made an exhaustive study of the literature with reference to developmental anomalies of this kind in idiots and mentions Bournville and Sollier's statistic,

comprising 758 cases of idiots which show such anomalies as phimosis, hypospadias, atrophy, retention of the testicle, various malformation of the penis, in a considerable number of cases.

Kneckt's statistic, covering 379 individuals belonging to this group, shows: phimosis 51 times; bilateral retention of testicle 11 times; atrophy of the testicle 18 times; epispadias twice, hypospadias 5 times; varicocele 12 times.

Uffreduzzi's own examinations made at Morro's Institute for Insane, covering 100 cases, show 47 simple epileptics; 7 epileptic idiots; 12 cretins; 14 phrenosthenics. In 18 of these 100 cases he found an ectopic testicle (6 bilateral and 12 unilateral).

Personally I believe that Uffreduzzi goes somewhat too far in his claim that in the great majority of cases of ectopic testicle there are other signs of degeneration. I believe a study of the statistics will show that while these various types of abnormal mental development have associated with them a large proportion of undescended or mal-descended testis, it does not necessarily follow that the reverse is true. Such a statement as Uffreduzzi's should be based upon evidence obtained from a very large number of cases of undescended testis. Our own observations at the Hospital for Ruptured and Crippled based upon 1,357 cases of undescended testis show that marked signs of physical or mental abnormalities are only associated with double undescended testis, and in but a moderate proportion of these. As regards the unilateral, undescended or mal-descended testis we have found no evidence showing that this is usually or frequently associated with other abnormalities.

As regards the pathology of the undescended testis, owing to the fact that we have from the beginning, strongly advocated attempting to save the undescended testicle and not to sacrifice it, we have had very little material for pathological investigation. Uffreduzzi states that the structure of the retained testicle varies greatly in the individual cases. The principal changes that are nearly always found are thickening of the tunica albuginea, and of the basement membrane of the tubules, and a great increase in interstitial cells. The epithelial lining of the tubules also shows very marked changes, the epithelial cells being few in number and more or less degenerated and irregular in shape.

In a chapter on the pathology of the retained testicle, Uffreduzzi discusses the varibus complications that are apt to accompany the condition of ectopic testicle and which, in order to differentiate them from the congenital complications, he designates as secondary or acquired. Among these are: pain and nervous disturbances; specific or chronic inflammation; gangrene and incarceration of the testicle; torsion of the cord in a series of 80 cases of torsion of the cord collected by Uffreduzzi, a retained testicle was found in 60 per cent).

The most common complication of undescended testicle is hernia of the congenital type, although in rare cases, it may be acquired. In all but two or three cases we have found a potential or actual hernia of congenital origin. Further complications are hydrocele of the cord and neoplasms.

That the retained testicle frequently becomes the seat of tumors, was first claimed by Lecomte, in 1851, and has since been confirmed by many others.

In my former paper[1] on the "Treatment of the Undescended or Mal-descended Testis," I stated that there was considerable difference of opinion in regard to the question of whether the undescended testis predisposes to malignant degeneration, and cited the various views pro and con. McAdam Eccles in his Jacksonian Prize Essay, 1903, stated that he had made an examination of 48,000 males with hernia at the London Truss Society, and found 2 per cent or 854 cases with undescended or mal-descended testes. Yet, in this entire series there was not a single case of sarcoma observed. He further stated that of 40 cases of sarcoma of the testis observed in one of the large London Hospitals during a period of 20 years, there was only one case of sarcoma of the undescended testis. From this fact he concludes that the generally accepted opinion that malignant disease is more common in the undescended than the normal testis, is not well founded. For many years I was inclined to agree with Eccles' opinion but further observations convinced me that it was wrong.

In my paper upon "Cancer of the Testis" with a report of 64 cases, read before the Southern Surgical and Gynecological Association, December 15, 1914, I stated that in 12 cases the sarcoma or malignant disease was associated with an undescended testis, and discussed the question of the relative frequency at considerable length. Different writers give different opinions as to the relative frequency of cancer of the normally descended and mal-descended testis. Odiorne and Simmons, in a review of 54 cases of malignant disease of the testicle observed at the Massachusetts General Hospital, found 6 or 11

[1] Ann. Surg., Phila., 1908, Sept.

per cent in which the disease occurred in the undescended testis; of these four were in the abdominal cavity and two in the inguinal canal. Rademacher gives the proportion of malignant abdominal to malignant inguinal testicle as 1 to 8. Meiser found 64 malignant inguinal against 4 abdominal testis. Bulkley, however, at the Presbyterian Hospital, found 2 cases of malignant abdominal to 12 cases of malignant inguinal testis. An analysis of the cases observed by Chevassu, Odiorne and Simmons and the Presbyterian Hospital records, show the proportion as 1 to 5. My own statistics show almost the same proportion, viz., 12 undescended testis in a total of 64 cases of sarcoma of the testis, or about 1 to 5½.

If sarcoma of the testis shows a relative proportion of incidence of 1 in the undescended testis to 5½ or even 8 in the testis in the scrotum, we have only to show that the relative proportion of undescended testis to normally placed testis is about 1 in 50 to prove that the abnormally placed testis is more prone to malignant disease than the normally placed.

With regard to the functional value of the undescended testicle, there is still a wide difference of opinion, some writers going so far as to state that it has no functional value whatever and for that reason advocate its removal. Uffreduzzi believes that a considerable number of undescended testes, 10 per cent, retain the power of reproduction. While the data at present is insufficient to enable one to express a positive opinion it is probable that Uffreduzzi's estimate is not far from correct. Aside from any functional value that the testis may possess there is another strong ground for preserving it,

particularly in children, and that is for the reason that the interstitial cells, which are always present have an important influence in developing the male characteristics of the child.

From January 1, 1890, to January 1, 1918, there have been operated upon at the Hospital for Ruptured and Crippled 334 cases of undescended testis, and since that time 31 additional cases (of these cases, 200 were operated upon by the writer personally, and the remainder by William T. Bull, John B. Walker, William A. Downes, J. P. Hoguet and the assistant surgeons); adding to these 50 cases operated upon at the Memorial Hospital we have a total of 415 cases of undescended testis. A most careful attempt has been made to trace these to final results.

In 49 cases the testis was found in the vicinity of the external ring just above the pubic bone; in 17 cases it was found in the upper scrotum; in 4 cases in the mid-scrotum, and in 16 cases it was impossible to locate it in any position (probably it had retracted in the abdominal cavity or had become too atrophied for palpation).

*Age*, as far as known, of patients operated upon for undescended testis.

| | Cases |
|---|---|
| Under 5 years | 33 |
| 5 to 10 years | 160 |
| 10 to 15 years | 133 |
| 15 to 20 years | 29 |
| 20 to 30 years | 16 |
| 30 to 40 years | 7 |
| 40 to 50 years | 5 |
| Over 50 years | 1 |
| Total | 384 |

The different varieties of ectopia or malposition of the testis are associated with

slightly different types of sac, or variations in the size and location of the vaginal peritoneum.

The most common type of ectopia is that in which the testis occupies a position in the inguinal canal, between the internal and the external ring. An interesting point in connection with this form of ectopia is that while the testis never goes beyond the external ring the tunica vaginalis may extend down beyond the external ring even beyond the bottom of the scrotum. In certain cases this pouch passes beneath the deep fascia and finds its way down into the perineum, and in some still more rare cases, it passes down into the thigh.

The next most common type of ectopia is that known as "inguino-superficial" in which the vaginal process passes out of the external ring then turns directly backward and upward and extends 2 to 3 inches toward the anterior superior spine. In these cases the testis usually occupies the distal portion of the sac and rests on the outer surface of the aponeurosis directly beneath the skin and superficial fascia.

It is evident that a diagnosis should be made in these cases before operation, otherwise in cutting down to the aponeurosis, the first landmark of the incision for Bassini's operation, one would first pass through the testis before reaching the aponeurosis. The testis can be so easily felt in this superficial condition that a diagnosis should practically without exception be made.

This type, which was a few years ago regarded as extremely rare is comparatively common, seventy-seven cases having been observed in the statistics which have been kept at the Hospital for Ruptured and Crippled.

Another type is the inguino-perineal in which the vaginal process for some unknown reason, instead of entering the scrotum passes beneath the deep fascia and extends into the peritoneum for a varying distance sometimes reaching nearly to the anus. I have observed 8 cases. In these cases the cord is usually normal in length and by making a new pouch in the scrotum the testis and cord can easily be transplanted in the scrotum without any tendency to retraction. In some of these cases the testis is normal in size and in other cases it is atrophied.

In a considerable number of cases a bilocular sac has been found in which the testis occupies the upper loculus which lies between the inner and external oblique muscle, the lower portion of which extends into the scrotum. In a smaller number of cases I have observed a bilocular sac, in which the upper portion assumes the inguino-superficial variety resting upon the aponeurosis beneath the skin and superficial fascia, and the lower loculus, extending down into the scrotum. In these cases the testis usually occupies the upper loculus.

*Operative procedure.* The method employed at the Hospital for Ruptured and Crippled since 1890 has been practically the Bassini operation without transplantation of the cord, namely: Bassini's incision, freely opening the aponeurosis of the external oblique well beyond the internal ring, surrounding the cord and hernial sac, which latter has always been found present with only two exceptions. Then the lower portion of the tunica vaginalis is grasped by an artery clamp and by traction the testicle is brought down as far as possible. The next step is separation of the sac from the cord, high up,

just outside the internal ring. In children this requires very careful and delicate dissection with thumb forceps as the cord is usually greatly enlarged and spreads out in a fan-like manner over an area of the sac one inch in width. If the dissection has been begun at the right layer, the sac can be easily isolated and is then tied off as high as possible. In most cases of inguinal and in many cases of the abdominal ectopia the cord can be freed sufficiently to permit the testicle to be brought at least into the upper portion of the scrotum, in most cases into the lower part, with the sacrifice of but few, if any, of the veins. Except in a very few of the early cases, I have never made any attempt to anchor the testis in the scrotum, but rely upon careful freeing of the cord high up and the removal of all fascial bands. Suturing of the testicle within the scrotum is, in my opinion, of little value. If there is any tension, the scrotum is retracted up toward the external ring. The canal is then closed by the modified Bassini method, without the transplantation of the cord. The cord is brought out at the lower end of the wound. The internal oblique is then sutured to Poupart's ligament over the cord. Great care is taken in placing the lowermost suture, which should include the reflected portion of the external oblique as well as the conjoined tendon and Poupart's ligament on the other side. This suture, when tied, makes but a very small external ring, too small ever to permit the testis to retract into the canal, even should it reach the ring.

In cases in which it is found difficult to get the testis into the scrotum, and this is particularly true in the abdominal variety of ectopia, the admirable procedure advocated

by Bevan, has been found of great value. In these cases we may remove not only the fascial bands, but practically all the veins and vessels, with exception of the vas and the spermatic artery.

Another excellent feature of Bevan's technique described in the *Journal of the American Medical Association*, 1903, is a purse-string suture in the region of the external ring, including the superficial and deep fascia, which not only prevents the testicle from entering the canal, but also from passing up on top of the aponeurosis.

Brief notes regarding patients traced from 10 to 20 years:

One patient, 15 years old, traced 19 years, testis in good position.

One patient, 13 years old, traced 20 years, testis atrophied and retracted to external ring.

One patient, 12 years old, traced 19 years, testis normal; patient married and has two children.

One patient, 10 years old, traced 14 years, testis found in normal condition.

One patient, 6 years old, traced 13 years, testis not felt.

One patient, 12 years old, traced 11 years, testis just below external ring.

One patient, 11 years old, traced 11 years, testis not down.

One patient, 11 years old, traced 11 years, testis not felt.

One patient, 10 years old, traced 12 years testis normal in size and position.

One patient, 14 years old, traced 12 years, testis found in inguinal region superficial to aponeurosis.

One patient, 10 years old, traced 12 years, testis atrophied and situated at the spine of the pubis.

One patient, 12 years old, traced 10 years, position of testis not stated.

One patient, 7 years old, traced 11 years. testis atrophied, lying on top of external oblique.

One patient, 10 years old, traced 10 years. The testis was situated well down in scrotum and was half the normal size.

One patient, 18 years old, traced 10 years—double one side in scrotum ⅔ normal size—other side not felt.

## Cases traced from 5 to 10 years.

One, 5 years old, traced 7 years, testis atrophied, outside of external ring.

One, 9 years old, traced 8 years, testis normal size, at bottom of scrotum.

One, 11 years old, traced 6 years, testis just without external ring.

One, 4 years old, traced 5 years, position of testis not stated.

One, 11 years old, traced 8 years, testis down and normal in size.

One, 5 years old, traced 6 years, position of testis not stated.

Double inguino-superficial, 10 years old, traced 5 years, position of testis not stated.

Boy, 8 years, inguino-superficial, traced and well 5 years, position of testis not stated.

Double, 11 years old, traced and well 8 years, size of testes not stated, right in scrotum; left in mid-scrotum.

Double inguino-superficial, boy 12 years old, traced 9 years, position and size of testes not stated.

Boy of 4, traced 5 years, position of testis not stated.

Boy of 14, inguino-superficial, traced and well 9 years, position of testis not stated.

Boy of 7, traced 9 years, testis can be easily pulled down into bottom of scrotum.

Boy of 14, double, traced 7 years, right testis, inguinal left, abdominal type, position of testes not stated.

Boy of 13, properitoneal, traced 7 years, testis outside of external ring, freely movable.

Boy of 6, traced 6 years, testis small, at bottom of scrotum.

Boy of 11, traced 6 years, testis half normal size, position external ring.

Boy of 4½, traced 8 years, testis not felt.

Boy of 8, traced 8 years, testis just above external ring.

Boy of 5, traced 5 years, testis at external ring.

Boy of 11, traced 5 years, both testes in bottom of scrotum.

Boy of 14, traced 5 years, position of testis not stated.

Boy of 13, double inguino-superficial, traced 5 years, both testes in scrotum and freely movable.

Boy of 10, traced 3 years, position of testis not stated.

Boy of 9, traced 5 years, position of testis not stated.

Final results in the cases observed at the Hospital for Ruptured and Crippled:

| Traced and Well | Number of Cases |
|---|---|
| More than 20 years | 1 |
| From 10 to 20 years | 16 |
| From 5 to 10 years | 41 |
| From 2 to 5 years | 60 |
| From 1 to 2 years | 31 |
| From 6 months to 1 year | 21 |
| Less than 6 months | 15 |
| *Not traced* | 149 |
| Total | 334 |

In the cases of adults as far as results are known, the testis has shown a greater tendency to remain in the scrotum than in children. The most important end-result in an adult is that in the case of W. N. male, who had double undescended testes 30 years, who was operated upon in 1895 on the left side by Dr. Schoonmaker, of Yonkers, and in 1910 on the right side by myself, at the Memorial Hospital. He was married in 1902 and had a child born in April, 1903.

This case is of particular interest, inasmuch as it is the second case that I have been able to find recorded in which a patient suffering from double undescended testes has become a father.

Another interesting case:

W. G., 37 years old, was operated upon 23 years ago for a right undescended testis. I had an opportunity of examining this patient on December 11, 1918, and found the testis absolutely in the bottom of the scrotum. It was normal in size and felt just a little less firm in consistence that the opposite testis. The patient was married two years ago and

up to the present time has had no children. In this case, I think, the longest period has elapsed since the operation (23) years.

## CONCLUSIONS

A careful study of our cases, together with the literature of the subject, has led to the following conclusions:

1. That in most cases of undescended or mal-descended testis, the etiology points to a congenital origin, often influenced by the element of heredity and frequently associated — particularly in the double variety — with other developmental defects.

2. The atrophy usually found in the undescended or mal-descended testis is not the result of the mal-position. The change in structure and the atrophy are merely coincident, being due to congenital causes.

3. The question of the functional value of the undescended testis, cannot be definitely answered in an individual case. It may be stated, however, as a general rule that an undescended or mal-descended testis, with which there is associated a marked atrophy, has little or no functional value. However, I believe with Uffreduzzi that in a considerable number of cases of undescended testis, spermatogenesis is retained.

4. The ectopic testicle is practically always associated with an open vaginal process of peritoneum; i. e., there is usually present a potential hernia. This vaginal process is almost invariably a congenital affair, for the reason that its position is entirely independent of the location of the testis.

5. Torsion of the cord is more frequently observed in the undescended testis than in the normal testis.

6. The undescended testis shows a greater

tendency than the normal testis to malignant degeneration.

7. Operation should be advocated in children who have reached the age of 8 or 10 years, for the following reasons: (a) Operation permits the radical cure of the hernia with which the undescended testis is practically always associated and which often cannot be controlled with a truss without causing pain and irritation to the testis. (b) By bringing the testis down into the scrotum before the age of puberty, there is a possibility of causing further and more normal development of the testis.

8. Operation in adults or children over the age of 14 should be even more strongly urged. for the following reasons: (a) In order to cure the accompanying hernia, as has already been stated; (b) in order to place the testis in a position in which it is much less subject to trauma; (c) in order to lessen the chances of malignant degeneration.

9. The end-results in our series show that it is possible to cure the hernia in practically all cases. Unfortunately, in only a comparatively small number of cases did we find the testis occupying the bottom of the scrotum in the cases observed, several years after operation. The atrophied testicle is generally found to have retracted to mid-scrotum or in the region of the external ring and in a position somewhat less liable to trauma than before operation. The result accomplished by the operation, the cure of the accompanying hernia, would seem to justify advocating operation for the undescended testis in adults.

10. The question of whether the traumatism incident to the operation on the undescended testis might not favor the development of malignant disease, is one that should

be considered — however at present it cannot be answered definitely. It should be noted that in none of the series of cases operated upon at the Hospital for Ruptured and Crippled during the past twenty-nine years has malignant disease been known to develop; however I have personally observed one case of sarcoma of the testis in which the disease was either present at the time or developed shortly after the operation for undescended testis; possibly it had already started at the time the operation was performed. (The operation was performed by another surgeon.)

These conclusions differ slightly from the conclusions of my earlier paper. In that paper I stated that the undescended testis is almost invariably of little or no functional value. I believe this statement is somewhat too strong and should be modified to the extent that the undescended testis is probably of functional value in not more than 10 per cent of the cases.

I still believe that the undescended testis should never be sacrificed in children and that the practice which obtains in some of our hospitals, of removing the undescended testis in a large number or even in the majority of cases, is greatly to be deprecated. Even if the testis be of little functional value, it nevertheless is of great value in developing the male characteristics in the child and promoting general health. In the adult it should likewise be retained for its influence upon the mentality and for the moral effect if for no other reason.

As regards the age for operation, I still believe that operation is seldom indicated under the age of 8 years. If the hernia is so slight as to be of little or no importance, it is

better to wait until the child is 10 to 12 years old before operating.

I still believe that abdominal ectopia, unless double, had best be left untreated, inasmuch as the operation is a difficult one and by no means free from risk.

In children, however, I would never allow a case of double undescended testes to reach the age of puberty. In these cases it is safer to do the operation in two stages, operating on one side at a time.

It is interesting to note that there has been no death in this entire series of 415 operations.